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THE

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BATTLESHIPS AND UNIVERSITIES.

AMONG the incalculable number of books, technical and lay, which have been issued in the English language, within the British Empire and in the United States, during the past 10 or 15 years, there are scarcely any, if any at all, which have been so worthy of publication as Capt. Mahan's "Influence of Sea-Power on History," and its allied successors. These books, written by a foreigner, an officer in a foreign navy, teach us the lesson that the greatness, almost the existence, of the British Crown at the present time is due to our command of the sea, and that, in fact, the power of Napoleon was broken at Trafalgar rather than at Waterloo. Similarly they teach that the future position of our country among the nations must depend upon the extent to which we retain our command of the sea; and since the modern ship of war is little but a portable laboratory for electrical, chemical, and mechanical engineers, Capt. Mahan implicitly teaches that, as a nation, we are dependent upon our scientific ability. Pondering on some such lines, we may suppose, Sir Norman Lockyer has seized the opportunity of his address as retiring President of the British Association to give us what is in parts a brief analogue of Capt. Mahan's masterpiece, in which the university takes the place of the battleship, the scientific educational staff of the country, that of an ideal Admiralty, and to which he has inevitably given the title of "The Influence of Brain Power on History."

Sir Norman Lockyer's address is far too replete with cogent argument and able illustration for us to attempt an abstract; but we may indicate the national requirements he points out. In the first place, we need a public body dealing with the organisation of science, which shall combine among its members, representatives of every branch of precise and codified knowledge, and shall, in season and out of season, impress its views upon the Government, upon our statesmen, and upon those of our politicians who are alive to a sense of their responsibility to the people; which, also, will put forward the scientific aspect of every question that comes before the community, relegating (perhaps) pure party spirit to a level more nearly corresponding with its merits, and preventing us any longer from having, *e.g.*, military systems, "unsuited," as Sir Henry Brackenbury recently said, "to the requirements of an army which is maintained to enable us to make war." It is curious and saddening to observe how even our faddists and "well-meaning" (than which there is no more condemnatory adjective in the language) persons have combined till their uproar moves governments and misleads the people; only men of science remain amorphous, until the lay journalist and the members of the public are ignorant of the very meaning of the word.*

* A short time ago a financial journal stated that a manufacturing concern was failing to achieve success because of too much *scientific interference* in its management!

In the second place, Sir Norman Lockyer wants a "duplication of the Navy Bill of 1888-9" in the direction of brain power, another £24,000,000 being set apart for the creation of intellectual battleships, *i.e.*, universities. In years gone by a large proportion of our naval force was made up of ships given or financed by private citizens; but as the empire has grown and the ships have become more costly, private enterprise has had to be abandoned, and the fleet made a national affair. Similarly (although, to the discredit of British millionaires, so much more is done in the United States for education by individual beneficence), the new universities we so urgently require—if our growing navy is not to guard a diminishing commerce, if a reduced national income is not to meet an increasing taxation—must be founded and maintained by the Government.

Sir Norman Lockyer, no doubt, was impressed by the fact that he was addressing (as president) the British Association for the Advancement of Science, which is a society founded "to . . . . obtain a more general attention to the objects of science and a removal of any disadvantages of a public kind which impede its progress," when he suggested that that body should constitute itself the new Chamber of National Science (to coin a title). Unless the B.A. is prepared to rise considerably to the occasion, we must regretfully part company with him here. The B.A. is an estimable society, very much in evidence for $\frac{1}{52}$ of the year, and having the ear of the papers, because it meets when we are holiday-making, and when the supply of crime and sensation is apt to be deficient: for the remaining 51 weeks it slumbers too peacefully to be a power in the land. This, however, is a matter of detail. Our other comments upon Sir Norman Lockyer's address must go deeper. The importance of his suggestion, and the advantage accruing to the community from its realisation, are not to be lightly passed over, and we should be the last to say an unfriendly or unsympathetic word. It is, we believe, proclaimed of Chicago, with pride rather than with shame, that that city wears out nervous force more rapidly than any other. Only Lewis Carroll's conspirators ever cried out for less bread and more taxes. Two thousand years ago we were warned of the danger of putting new wine into old bottles. There is a physiological question here which takes precedence over all others. Our race, or sections of it, shows well-marked symptoms of physical deterioration. Before we can enter whole-heartedly into a vast scheme for more perfect and longer training of the growing generation, before we can agree to the heavy extra taxation it will involve, we must have the assurance of a body of highly-skilled physicians that our youth can bear the added strain without suffering in health and constitution. Or rather, a method must be elaborated—if it be anyway possible—between our physicians and our educational experts for giving such extra training in improved conditions which shall not merely stem the tide of physical decay, but shall actually improve the physique as well as the intellectual capacity of the finished students.

MUNICIPAL TELEPHONY.

The recent Local Government Board inquiry at Hull, of which we conclude a report elsewhere in this issue, and the discussion last week of the Glasgow Corporation Telephone Department finances by the Town Council of the "second city," afford plentiful material for a few passing observations on the latest form of the craze for municipal trading. The proceedings at Hull show very clearly the haphazard manner in which Town Councils are willing to rush into the telephone business under conditions which, so far as we are aware, are not supported by any other authorities on telephone exchange working. It appears that the original report was prepared early in 1900, and was in no way amended this summer, when it was decided to proceed with the scheme, although three years are known to produce important changes in telephone practice, and although the local telephonic conditions had greatly changed in the interval. Further than this, it is clear from the evidence at the inquiry that, apart from practical imperfections in the proposed system, neither the report nor the estimates paid adequate attention to the important question of spare plant. There is a consensus of reliable telephone opinion and experience that not much over 60 per cent. of the plant of a large and growing telephone system can be in use at any given time. The effect of this on the average capital cost per subscriber is apparent to anyone who gives close study to the practical conditions of the telephone exchange business; yet the advocates of municipal telephony never, to our knowledge, have given this important factor its true value in considering the cost of conducting a telephone service.

We note with surprise that at the Hull proceedings, the switchboard was considered to be a mere mechanical detail not worth discussing. It appears that a switchboard on the old-fashioned magneto "ring-through" system was originally recommended, but at the inquiry this specification was thrown overboard, and it was stated that a different system was to be adopted, which the Corporation witness refused to describe. The inspector subsequently ruled out questions relative to the switchboard, on the ground that it was an unimportant detail, not affecting the actual object of the inquiry. Since the style of switchboard not only dictates the whole arrangement of the exchange, the construction of the subscribers' instruments, and to a certain extent the design of the subscribers' lines, but also directly governs the kind of service that is to be given, it is astonishing that any man qualified to preside at a telephone inquiry should deem it to be a detail of no importance.

Hull, at any rate, has been thoroughly warned by the ventilation of the subject at the late inquiry, and will doubtless not venture to proceed with its telephone scheme on the lines originally laid down. But what is to be said of Glasgow? Glasgow is wallowing deep in the mire of an unsound and uncommercial telephone enterprise, and is making the most prodigious splashing and shouting in order to conceal from the uninitiated the real state of affairs. Glasgow, like the other municipalities that have taken up the business of telephony, was led into it on the basis of estimates purporting to show that the average capital cost of telephoning a town ranges from £18 to £20 per subscriber's *line*. The Glasgow accounts recently published show a total capital expenditure of £270,000 for 9,122 *instruments*, an average of over £29 10s. per instrument. One does not need to have built the first telephone line in London to know that in a modern telephone system all the instruments do not represent lines. Many subscribers' lines have two instruments on them, some have ten or a dozen. Yet in the discussion at Glasgow these 9,000 instruments

are freely flourished as "subscribers." If the Glasgow Corporation telephone statistics were more completely stated, the accounts would bear a very different interpretation from that put on them in the Chamber of the Glasgow Town Council.

As to the operating expenses at Glasgow, there are but two comments to be made, both arising from the report of the auditors. No practical man believes in municipal accounts, and we are, perhaps, greater disbelievers than most; if so, we find weighty confirmation of our distrust in the comments of the auditors on the accounts of the Telephone Department of the Glasgow Corporation. It is there pointed out that no depreciation has been allowed for at all. Depreciation is a well-recognised item of telephone expense, and at Glasgow it ought to assume a large figure, as much of the Corporation telephone system is well known to be fit only for the scrap-heap. Another paragraph in the auditors' report runs as follows:—"*In our opinion the time has now come when the canvassing expenses should form a charge against revenue.*" This recommendation throws such a peculiar light on the methods by which the operating expenses of the Glasgow Corporation Telephone Department are calculated that it needs no comment whatever.

A Voice from Shanghai.

It is not only in the United Kingdom that private electrical enterprise is in the hands of the municipal oppressor. Shanghai has for some years past had its own controversy, in which the electrical contracting firms have wrestled with the municipality and its electrical department respecting the injustice which they impose by carrying on business as electric fittings suppliers and installation contractors. Over and over again have the affected firms tried to knock something akin to fair dealing into the ways of the Council, but without satisfaction. It is quite likely that one of the points used by the complainants in their arguments with the municipality was the refusal of our House of Commons to let the London County Council, and those for whom it acted, have the wiring and fittings clauses embodied in a recent Bill. But what does the Shanghai Council say to this? We do not quote the exact terms, for the discussion is too lengthy; but, in brief, this is the line of defence adopted:—"England and Shanghai are not the same place . . . . At Shanghai there is no Local Government Board or Board of Trade to prevent our carrying on the work in the manner which expediency may suggest, even though such may be contrary to the custom elsewhere. There is none to correct us, so we may transgress as we please." Here, indeed, is a dignified attitude for a twentieth century municipal corporation to adopt. We tremble to think of what might become "expedient" to the municipal mind! But, happily, if there be neither L.G.B. nor B. of T., there is a Board of Consuls; and we shall not be at all surprised if the matter finds its way there before very long, should the Council still continue to fail in its duty to the ratepayers who trade within its borders. The accusers say that the municipal department is fitting up houses at bare cost, and that competition under such conditions is well-nigh impossible. "If you wish to confer advantages upon the public, reduce the price for energy; there is ample margin, and you will thereby be enabled to check the present tendency to instal private independent plants, and will give a further incentive to the use of municipal electrical energy." The soulless municipal retort is this:—"To cease supplying fittings and fans, to withdraw our offer of deferred payments, to abandon our idea of establishing a showroom in the Nanking Road district, would inflict injury upon the general interests of the ratepayers, and private firms would keep up the price of fittings so as to render them too expensive for the poorer classes of consumers." Then, of all other arguments the least worthy: "Supposing the quality of your fittings was so poor that the electrical department could not pass them (!), and supposing your stocks run out." Then, again: "We used to do a good deal worse than we are doing now, for we used to supply plant to any and everybody who came to us; now we only supply to our own consumers." The remark respecting quality is really hardly worth taking into consideration, for the Corporation has itself already committed the error of importing a large quantity of "cheap and defective" incandescent lamps from Italy; these, after supplying to consumers, had to be replaced at considerable loss to the department, by a lamp of superior material. It would have been better for the electrical engineer to have held his peace respecting quality after that municipal error. He admits that much trouble and labour would be saved by giving up the supply of fittings, and thus poses as a martyr to the public good.

It may be thought that the matter is a local one; but the Shanghai electrical contractors will, if we mistake not, find many a sympathiser among those at home who have had some experience of municipal rivalry and tyranny in the same direction. We hope they will soon succeed in instilling something of the principles of common justice into the minds of Shanghai Councils and their permanent officials.

The Mono-Rail.

It is only a short time since the prospectus was issued for the high-speed electric railway which it is proposed to construct on the Behr system from Manchester to Liverpool. As our readers know, the Bill for this line was granted by Parliament some time back, but up to the present nothing has been done to realise the project. Various descriptive articles, with photographs of Mr. Behr and his proposals, have recently appeared in the daily press. The question of high speeds is one which greatly appeals to the general public: but it remains still to be seen whether they will be prepared to pay the higher rates which high-speed travelling will certainly entail. The proposed Manchester and Liverpool line, if constructed, will be the first on which speeds up to and over 100 miles an hour will be realised in practice, although a long series of experiments have been carried out on a military line in Berlin, but so far without any apparent practical results. This so-called mono-rail system is well known to our readers; but we must confess to serious doubts as to whether any of the glowing results which have been foretold by its prophet, Mr. Behr, will be realised. We fail to see the great advantages of the mono-rail, which in reality is a five-rail track, as besides the rail on which the weight of the carriages is to be carried there are four other guiding rails. We should have preferred to have seen a first-rate standard permanent way construction; and if any safety device were thought desirable, it could have been provided by means of a couple of guard rails situated either between or at the side of the main tracks. It is well known to all railway men that speeds of 80 and 90 and even up to 100 miles an hour are perfectly safe on ordinary railways, if properly constructed, and that the only reason why the higher speeds have not, up to the present, been adopted by railways is due to the cost of working at such high speeds. This fact has been clearly demonstrated over and over again in the long-distance high-speed runs which have at various times taken place in the "race to the North." We must admit that, after the most careful study of the proposed Behr construction, we do not see anything to recommend it, or which would appear to make it more advantageous than first-class ordinary railway construction.

While criticising Mr. Behr's suggestions, we cannot help admiring his pertinacity, and we shall certainly look forward with great interest to the results which he hopes to achieve on the Liverpool and Manchester Railway. It seems only appropriate that such a radical departure should take place on such historic ground as that on which the first battle of the railways was originally fought.

D

THE GAS ENGINE AND ITS FUTURE.

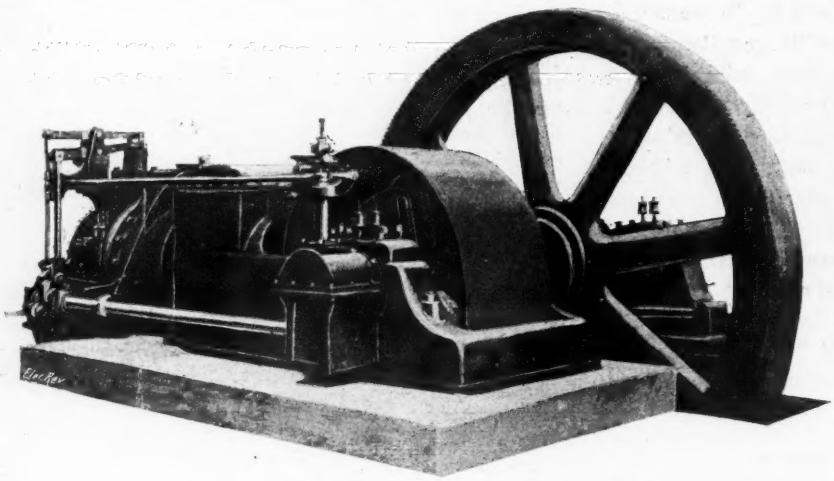
(*Continued from page* 369.)

The Premier Gas Engine.

The Premier Gas Engine Co., Ltd., of Sandiacre, near Nottingham, make a speciality of an engine of the positive scavenging type, which has given excellent results under test. Up to the present date, including engines from 150 H.P. upwards, with orders in hand, the aggregate is 14,800 H.P. Single cylinder engines are made in sizes of 150, 200 and 250 I.H.P.; above this power and up to 1,200 I.H.P., two cylinders are placed in tandem. For units

	Cub. ft.
Mond gas at 0° C. per I.H.P.-hour	52·09
" " B.H.P.-hour	69·20
" " E.H.P.-hour	74·42
" " Board of Trade unit	99·76

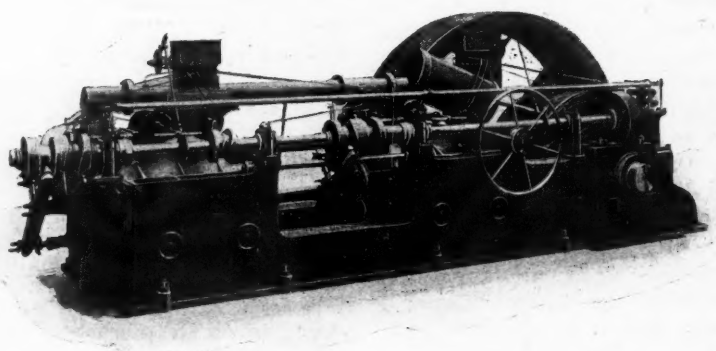
Thermal efficiency.	Calculated on "higher" thermal value.	Calculated on "lower" thermal value.
	Per cent.	Per cent.
Calculated on the I.H.P. ...	30·38	34·00
" " B.H.P. ...	22·87	25·59
" " E.H.P. ...	21·27	23·80



Premier Type: Fig. 1.—250-H.P. Engine.

above 1,200 this firm offers four-cyinder, or double tandem engines.

In the latest engines a separate cylinder is provided for supplying the scavenging air supply, as will be seen in the illustrations, figs. 1 and 2, and though the maximum diameter of cylinder has not yet been decided upon, they have an engine in hand with cylinders of 38 in. diameter, designed for a maximum piston speed of 750 ft. per minute. This firm claims to be the first to use water-cooled valves and pistons, at least in this country.



Premier Type: Fig. 2.—400-H.P. Engine.

For electric lighting work governing is effected by reducing the gas and igniting every cycle. This, combined with large fly-wheels strongly made so as to stand high rim velocity, gives sufficiently steady running (even with single-cylinder engines) for incandescent lighting. Premature ignition is prevented by the positive scavenging arrangement. Four-cylinder engines of this type with fly-wheel alternators take up, power for power, rather less room than the vertical cross-compound Corliss steam engine and alternator.

A Premier engine of 500 H.P., having two cylinders arranged in tandem, when tested with Mond gas, gave the following results* :—

Indicated H.P. (three-quarter load), 489 21.

Combined efficiency E.H.P./I.H.P., per cent., 70·0.

Mechanical efficiency of engine, excluding fluid losses, 81·22 per cent.

* "Power-Gas and Large Gas Engines for Central Stations," by H. A. Humphreys, M.I.Mech.E., before the Institution of Mechanical Engineers, December, 1900.

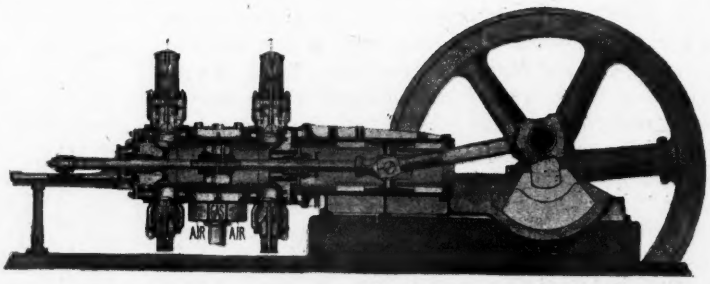
With cylinders of 27-in. diameter, the speed is 150 revolutions per minute, while with cylinders 28½ in. diameter, the engine runs well at 125 revolutions per minute.

Though this firm employs the skew-gear method of driving the side shaft, it will be noticed that the cams are of the grooved type; the valve levers have coned rollers, and the valves are both opened and closed mechanically.

Deutz Gas Engine.

Of the gas engines manufactured by the Gasmotoren Fabrik Deutz, fig. 1 shows in section a single cylinder, double-acting four-cycle engine, for which we are indebted to *Die Gasmotorentechnik*, 1903, No. 10; and fig. 2 is a perspective view of an engine coupled to a dynamo.

This firm has made a large number of gas engines for driving both continuous current and alternating generators. It will be noticed that the inlet valves are of the inverted mushroom type, and situated



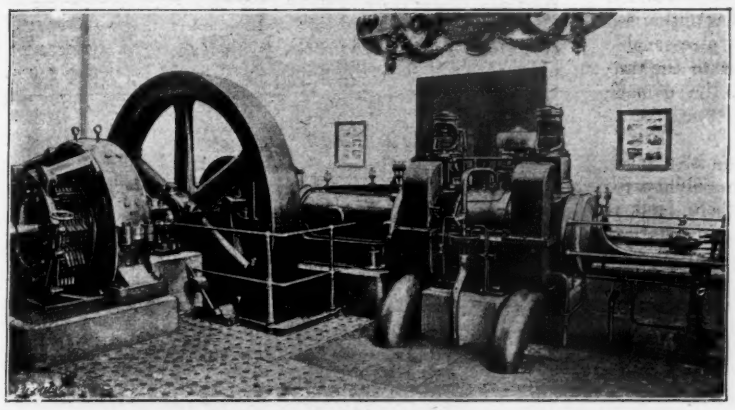
Deutz Engine: Fig. 1.

directly above the exhaust valves, the sectional views fig. 1, requiring little explanation. The piston and gland, are water-cooled, as well as the cylinder and exhaust valves.

Four-cylinder engines of this type have been constructed to give 1,200 H.P., and a number of these engines of 1,000 H.P. are driving alternators in parallel, coupled direct, and using blast-furnace gas, the governing being effected by controlling the supply of explosive mixture of gas and air to the cylinders in proportion to the speed,

Oechelhäuser Gas Engine.

The Oechelhäuser engine, a type manufactured by a number of German firms, differs considerably from other types described, in that the cylinder is fitted with two

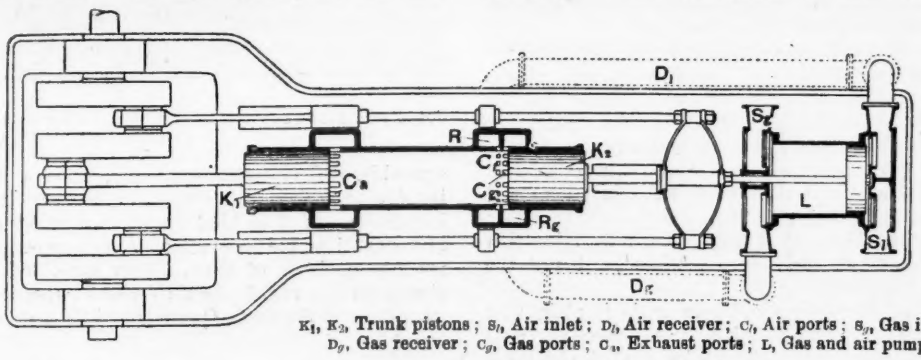


Deutz Engine: Fig. 2.

pistons, though the exhaust is by means of slots in the cylinder walls, somewhat similar to the Körting engine.

The explosion of the mixture of gas and air taking place between the two pistons, they are forced in opposite directions, and to accommodate this arrangement the crank-shaft has three cranks; the front piston is directly connected to the central crank in the usual manner, but the back piston has a cross-head with side rods, which, by means of connecting rods, actuates two cranks at 180° with the centre crank. An extension of the back piston rod has a piston attached, which constitutes a gas and air pump.

For driving dynamos this type of engine is built in units varying from 300 to 1,000 H.P., several engines being employed for driving alternators in parallel.



K_1, K_2, Trunk pistons; S_l, Air inlet; D_l, Air receiver; C_l, Air ports; S_g, Gas inlet D_g, Gas receiver; C_g, Gas ports; C_a, Exhaust ports; L, Gas and air pump.

Plan of Oechelhäuser Engine.

(*To be continued.*)

THE LAW OF NUISANCE.

Perhaps there is no industry more nearly affected in modern times by the law of nuisance than that which has to do with the spread of electricity as a means of distributing light and power. We do not say that electricity itself is often the *causa causans* of an action for nuisance; indeed, there are only a few cases on record where actions have been successfully brought to recover damages for injuries alleged to have been caused by escaping electricity. But within the last few years the introduction of tube railways has led to a number of questions between the promoters of these undertakings and the owners of property whose comfort is interfered with, either during construction or working, and in view of the fact that many tubes are about to be laid beneath the metropolis, it is of the greatest importance that the law of nuisance should be clearly understood.

A recent case in the High Court is typical of the kind of claim which may be made against a tube railway company when commencing their undertaking. It appears that an action was brought by the owner of certain flats in the neighbourhood of Sloane Square for an injunction to restrain the Great Northern, Piccadilly and Brompton Railway Co. from creating a nuisance. The company had found it necessary for the purposes of their undertaking, and in order to clear away the soil taken from this section of the tunnel and to connect the station with the tunnel by a subway, to sink a shaft within 25 yds. of the plaintiff's premises. The work of clearing away the tunnel soil was carried on continuously, day and night, and the plaintiffs complained of (*a*) carting clay, earth and other materials between 10 p.m. and 8 a.m.; (*b*) rocking and emptying earth wagons between the same hours; (*c*) hammering timber and using a steam crane between the same hours; and (*d*) shouting, singing, and bawling by day and by night.

The plaintiffs contended that the defendants could not discharge the onus of proving that the work they were doing was within their statutory powers, that it was being done reasonably, or that it was reasonably necessary for the work authorised to be done. The defendants, on the other hand, relied on their statutory powers, and called Sir Benjamin Baker and Sir Douglas Fox to show that they were acting reasonably in the construction of their works. It was shown, however, that prior to November, 1902, the defendants had been carrying out their operations as ordinary lessees, and were not then acting under statutory powers. In respect of the nuisance occasioned during this time, the Judge awarded the plaintiffs the sum of £20 damages, but upon the rest of the case he said:—

"In this case, if the railway company were using all the reasonable care which experience and engineering skill could devise, they are absolved. Public works of this kind must be extremely objectionable to people in the neighbourhood, but the question is whether the annoyance can be avoided in the reasonable carrying out of these works according to the best methods, in the light, not only of what was done in other cases, but of the knowledge which engineers in command have acquired from those cases. In my opinion, the railway company has, upon the whole, so acted reasonably, and they have promised to do what they can to reduce the noise of rocking the skips by the use of wooden instead of iron shovels. It would be equally unreasonable to require them to acquire more of the land, which they had, in fact, scheduled, when what they were now doing worked well." His Lordship also quoted with approval the following dictum of the Master of the Rolls in the case of Southwark and Vauxhall Water Co. *v.* Wandsworth Board of Works (1898) 2 Ch. 603, where he said:—"The only obligation on the defendants was to use reasonable care to do no unnecessary damage to the plaintiffs."

Where a private Act of Parliament is silent as to nuisance, the company are exempt from liability except to the extent laid down by the House of Lords in Geddis *v.* The Pro-

prietors of the Bunn Reservoir (3 App. Cas. 455) where Lord Blackburn said:—"It is now thoroughly well established that no action will lie for doing that which the Legislature has authorised, if it be done without negligence, although it does occasion damage to anyone; but an action does lie for doing that which the Legislature has authorised if it be done negligently, and I think that if by a reasonable exercise of the powers either given by statute to the promoters, or which they have at common law, the damage could be prevented, it is, within this rule, negligence not to make such reasonable use of their powers."

It may be observed that Lord Cross's Committee made certain recommendations with regard to the liability for nuisance. They expressed the view that where land is taken compulsorily for the purpose of a generating station, the undertakers should not be subjected to any further liability than that which, according to Lord Blackburn, is imposed by the common law in the case of persons exercising statutory powers and duties. On the other hand, where the site for a generating station is acquired by agreement, the Committee are of opinion that the undertakers ought to be subject to the liability imposed by the common law.

What, then, is this liability at common law?

This question is best answered by reference to the case of Shelfer *v.* The City of London Electric Lighting Co. (1895, 1 Ch. 287). In that case an electric lighting company erected powerful engines and other works on land near a house which was subject to a lease. Owing to excavations for the foundations of the engines, and to vibration and noise from the working of them, structural injury was caused to the house, and annoyance and discomfort to the lessee. The lessee and the reversioners brought separate actions against the company for an injunction and damages in respect of the nuisance and injury thus occasioned.

Mr. Justice Kekewich, after finding in the evidence that the defendants had created a continuing nuisance as regards the lessee, and had caused a structural injury to the house, held that both the lessee and the reversioners were entitled to relief, but under the circumstances, by way of damages and not of injunction. The plaintiffs in both actions appealed against the refusal of the injunction; and the Court of Appeal held that there was nothing in either case to justify the Court in refusing to aid by injunction the legal rights which had been established, and that the appeal should be allowed.

The foregoing observations will have made it plain that the tendency of modern legislation is to relieve electrical companies and companies which make use of electricity from the risk of vexatious actions for nuisance; inasmuch as every undertaking of any magnitude necessitates the compulsory purchase of land.

But there are other causes operating in a similar direction. The Courts by slight and almost unnoticeable changes are gradually modifying their rigorous attitude towards nuisances which are created in the interest of the public at the expense of individuals. Moreover, regard is had to the situation of the works in question. What would be a serious nuisance in Belgravia is not out of the ordinary in Whitechapel.

It follows that so long as the promoters of an electrical undertaking pay all proper regard to the comfort of those who live in the neighbourhood of their works, and do as little damage as possible, there is but little fear of the aid of the Courts being invoked to restrain the progress of the works by injunction.

ELECTRICITY ON THE FARM.

By E. GUARINI.

Among the innumerable and ever-increasing applications of electricity, those of agriculture, while not of secondary importance, are none the less somewhat rare. Nevertheless, we can say without fear of making a mistake, that the future of agriculture is an important factor in the applications of electricity. Electricity responds to all the needs of modern farming. By electricity we can increase the produce of the earth more quickly than by any other means; by electricity we can work vast expanses of land more quickly and better than by steam; one can work at little expense all agricultural machines—the most easily divisible of all forces, electricity permits of great economy; and, lastly, farms can be lighted in a manner at once more hygienic, less costly, more

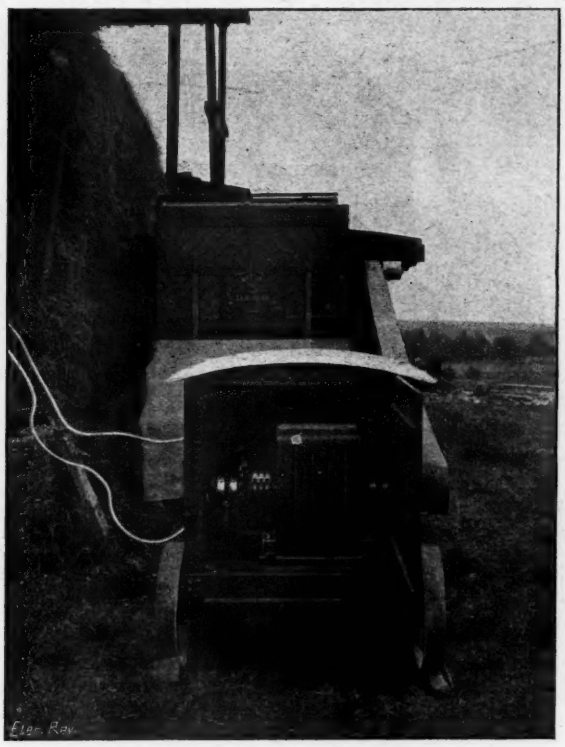


Fig. 1.—Helios Portable Motor for Agricultural Purposes.

agreeable, and especially more safe, since a well-arranged installation makes fires almost impossible. However few installations of this kind there may be at present, one important firm, the Société Hélios, of Cologne, seems to have made a speciality of them. They have, indeed, fitted up almost all the model electric farms in Germany, in particular those of Simmern, Quednau and Crottorf.

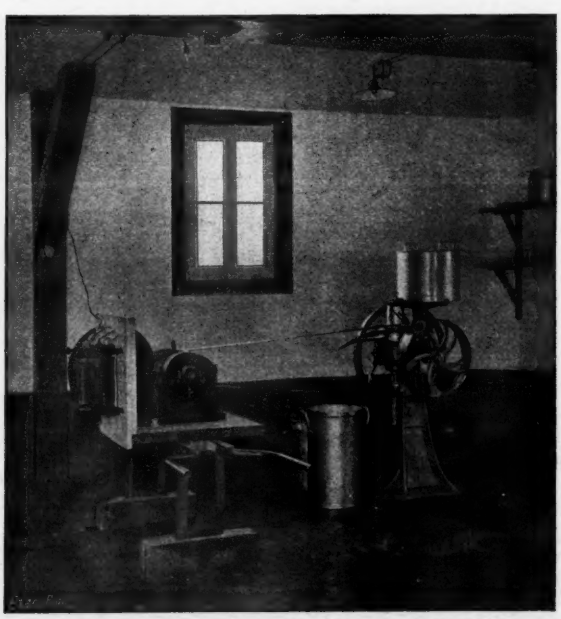


Fig. 2.—Motor Driving Cream Separator.

These three establishments differ in the means employed for the production of the electricity.

At Simmern the source of energy is the river, at Quednau it is a steam engine, and at Crottorf a waterfall is

utilised, which is assisted during periods of drought by a steam engine.

At Simmern, the turbine constructed by Bèché drives an 11-KW. dynamo (110 volts), connected with the mains, and with a battery of accumulators of 62 elements, having a capacity of 95 ampere-hours (for a 10-hour discharge). During the periods in which the entire output of the dynamo is not needed for the farm work the surplus is used to charge the accumulators. On the other hand, when the output is not sufficient for the needs of the farm, the accumulators are used as well. We will not describe the lighting arrangements, as they present no new feature.

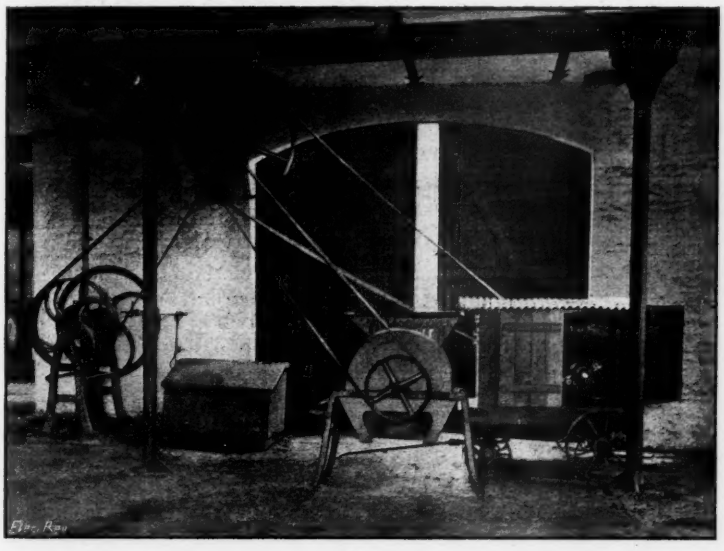


FIG. 3.—PORTABLE MOTOR DRIVING FOUR AGRICULTURAL MACHINES.

The choice of the motors has been guided by the desire to replace as far as possible men and animals. They are therefore all easily portable. Moreover, for machines needing a certain power, it has been considered sufficient to instal only one motor powerful enough to work them all. The employment of a special motor for each machine has been generally avoided, because the efficiency of small-sized motors is less than that of large ones. The motor is placed near the machine it works, and is carried in a kind of wagon.

At Simmern the motor used is of 10-H.P., running at a speed of 1,200 r.p.m. (fig. 1). The truck with the electro-motor is better than a steam engine, since, apart from the danger of fire, it does not need a skilled operator; the connections once made, it can be immediately started, differing in this respect from the steam engine which requires the presence of a mechanic, and needs one or two hours stoking before it will go. However, in agricultural matters, to get the whole of the advantages of an electro-motor, the work must be judiciously divided among the various machines.

When the latter are on a platform, a small motor is used to work them, fixed on planks, and movable by two men. Fig. 2 represents, for example, how a small motor of ¾ H.P. works a centrifugal separator, capable of separating the cream from 430 litres of milk per hour.

The large 10-H.P. motor on the truck drives by a belt a carrot cutter (fig. 3), placed at the side of the motor, and cutting 650 kg. per hour, as well as a machine for crushing cakes of linseed at the rate of 500 kg. per hour, and lastly, a pump delivering 10 cubic metres per hour, supplying water to the stables.

The same motor, which is powerful enough to work a threshing machine, also actuates, by a belt through the platform, a straw-cutting machine, capable of giving 150 kg. per hour.

The connections, being of flexible cable, permit of the motor being placed in any position.

The employment of electricity has given at Simmern, besides considerable advantages, unbounded satisfaction.

The farm at Quednau belongs to Prof. Backhaus, of the University of Konigsburg, and has an area of only 165 hectares. A dairy has been established there capable of giving 10,000 litres of milk daily. Here has been installed the power station.

A "Wolff" engine of 50 H.P. serves the dairy, and drives two dynamos; the first, a four-pole machine giving 90 amperes at 500 volts, serves the motors some distance away; the other, a two-pole machine, gives 30 amperes at 220 volts, or instead 18 amperes at 320 volts. In the latter case, it is used to charge a battery of accumulators (Pollak system) of 120 elements. These accumulators are used for the lighting of the farm and fields, as well as for running several motors in the evening, when the steam engine is stopped.

The current produced is led from the switchboard to the motors and the lamps, the latter being abundantly distributed over all parts of the farm, arc lamps in the yard and incandescent lamps in the dwellings, stables, barns, kitchens, &c. Electric heating, besides, is in use at Quednau. Whereas at Simmern two motors were sufficient, at Quednau it has been deemed necessary to have three.

FIG. 4.—PORTABLE TRANSFORMER.

The first, a fixed motor of 2½-H.P., drives a machine for straw cutting and another for carrot cutting; the second, a portable one of 15-H.P., drives, by means of belting, two mills, a machine for crushing cakes of linseed, and a water pump; it is also used for a thrashing machine and a circular saw. The last motor, also portable, is generally used in the granary, and drives a mill. It is connected up to the lighting cables.

Apart from the motors referred to above, Quednau possesses an electric plough. The Hélios Co., who have made the installations, construct two types of electric ploughs, worked by a motor with a stationary car or instead by two motors. The first of these systems consists of (*a*) the car carrying the motor, which is placed on one side of the field; (*b*) the stationary car placed on the opposite side;

and (*c*) a rope to transmit the motion. In the second system, the stationary car is replaced by a motor, then one of the motors serves for the going and the other for the return of the plough. The first method is less expensive than the second, but the latter, which absorbs as a maximum 60 H.P., ought to be employed for very hard earth and for the ploughing of furrows ·36 metre deep or more. This latter type is used at Quednau. In a report which Dr. Backhaus has made on the results of his experiments, he declares that electricity is capable of rendering great services to agriculture, especially if the farmer owns a waterfall.

Fig. 5.—Sub-station at Hordorf.

In many cases, however, the working can only be made economical by the addition of a fairly important industry. At Quednau, a comparatively small enterprise, electricity replaces 12 horses and eight men; unless this were the case, either the value of the products would suffer or the work would not be done so well. The most important item in the general expenditure of a farm is that of working expenses. Diminish the latter by the aid of electricity, and we shall see agriculture regain its position wherever the cost of an installation is not insurmountable.

The addition of a secondary industry is not, however, a *sine quâ non* of economy for an electric farm. The same result can be obtained by the association of several farmers for the use of current supplied by a central station. The station at Crottorf, in the province of Saxony, demonstrates this fact. Use is made of alternating currents at 7,000 volts, from 500-KW. alternators. The voltage of 7,000 is justified by the fact that the distribution is scattered over districts with a radius of 30 kilometres. The power is obtained from a waterfall of a height of 2·7 metres, with a volume of 6,450 cubic metres per min., acting on three turbines; these, by means of gearing, work a common shaft, which is directly connected to the alternator, also driven by a steam engine, if necessary. Another generator is installed, worked only by a steam engine. For the average demand of current, the turbines, which represent 350 H.P. to 500 H.P. are sufficient. When the volume of water is insufficient for their needs, or when the demand is too much for them, the steam engine is used with them. Here, where we cannot be certain of hydraulic power, the steam engine alone is sufficient for the production of the current, and can cope with the demand. The current is directed to the necessary places through sub-stations, in which, by means of rotary converters, the alternating current at 7,000 volts is transformed to a continuous current of low pressure suitable for lighting purposes. Respecting the lighting, every sub-station is provided with accumulators, which are charged during the day, and at night time are used in conjunction with the converters.

From henceforward the utility of the station is assured. The machines thus utilised are, moreover, of little consequence in comparison with the end attained. For working the motors recourse is had to a special circuit, with a low-pressure current, transformed from an alternating high pressure current by the sub-station converters.

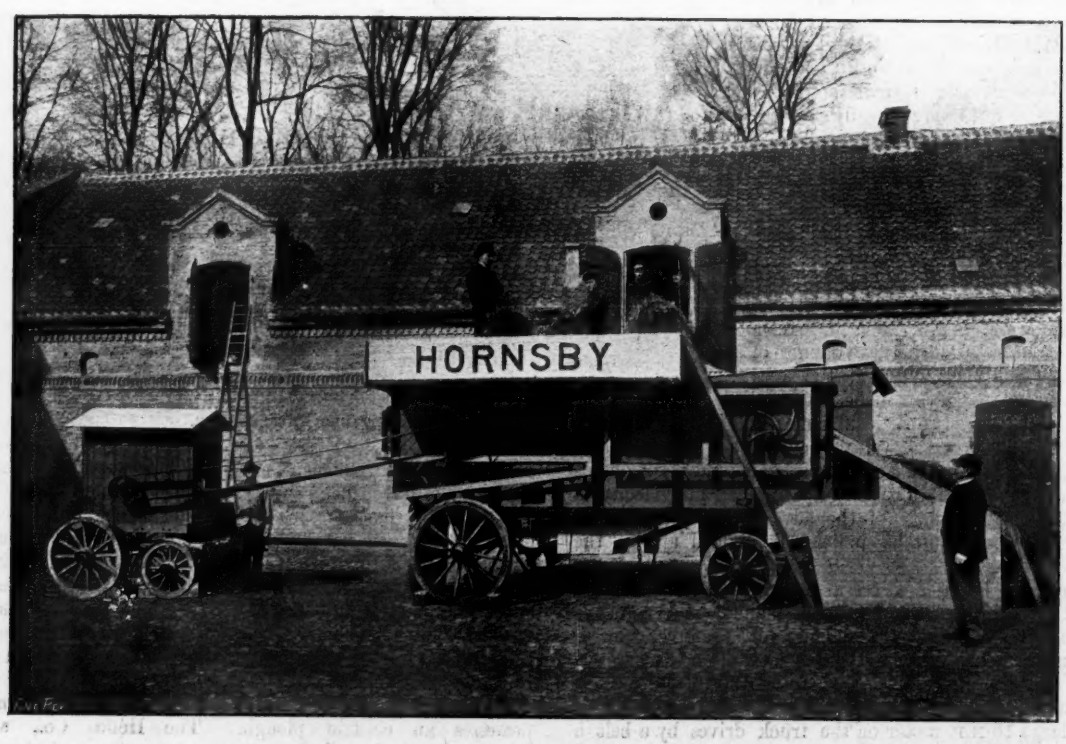


Fig. 6.—Electrically-driven Threshing Machine at Crotdorf.

Fig. 5 represents the sub-station at Hordorf. When the sub-station only contains a transformer, it is sheltered by a sheet-iron construction. If the transformer is, on the other hand, of very small size, it is placed on poles. What has been especially tried at Crottorf is the use of electricity for threshing corn. Fig. 6 shows an installation of this kind with a portable motor. There is at Crottorf also a kind of movable sub-station, which can be connected up wherever desired, even in the open fields, to the main high pressure cables (fig. 4). It is to be hoped that the farmers in the Crottorf district will understand the profit to be obtained from such an installation. The foregoing article, although briefly expressed, will show, we hope, how great an economical importance electricity has for agriculture, and we do not think we are premature in asserting that in electricity will be found the future of the mother of industries.

NEW METHOD OF JOINTING AND SUPPORTING TRAM-RAILS.

In the accompanying drawings we show a new patent system which has been jointly devised by two members of the City Surveyor's staff at Sheffield. It consists of a transverse girder passing between and under the tram-rails, and carrying two plates. The plates in turn support and are secured

Fig. 1.

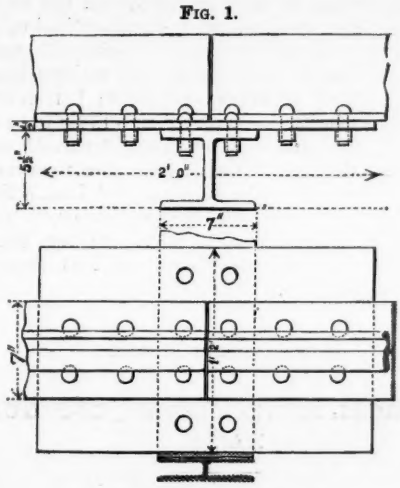


Fig. 2.

Fig. 3.

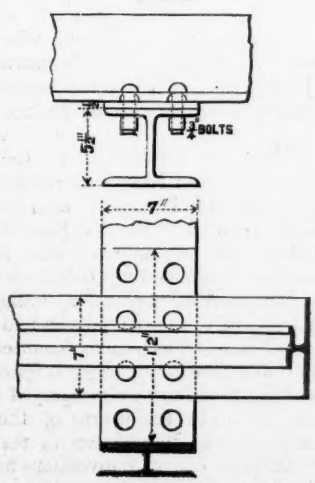


Fig. 4.

to the tram-rails at the joints, and also at the centre of the rails, which may be of any length and laid to any gauge. The plates on the transverse girder will be bolted or riveted to it before arrival on the site of the works. The necessary bolt or rivet holes will be drilled or punched in the plates, girders and tram-rails, in their correct positions at the shop, so that the drilling of further holes on the site of the works will be rendered unnecessary. In double junctions and on curves where the joints of the tram-rails do not come opposite one another the transverse girders can, if necessary, be shortened, though this will be avoided as much as possible, and the transverse girder carried from rail to rail. Cases will occur in which the plates to carry

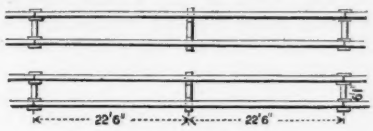


Fig. 5.

points and rails will vary in shape and size, and in which the transverse girder will have to carry more than two plates and rails, but the patent will be equally applicable to these and similar cases.

It is claimed by the patentees that the adoption of their method will render the use of fish-plates and tie-bars unnecessary, will prevent the vibration so common in tram-rails laid according to present methods, which is so detrimental to the wear of the rails, and which causes the displacement and consequent expense in the maintenance and repair of the paving. It will also secure greater uniformity of track than is possible under present conditions, as the transverse girder embedded in concrete will secure the one rail firmly to the other.

BERLIN AND SANDY POINT.

The *Cologne Gazette* last week gave a semi-official report of the "preliminary" Wireless Telegraph Conference which was held last month in Berlin, the President being Herr von Sydow, Under-Secretary of State for the German Post Office. The report formulates, as resolutions, a proposed agreement between the Powers to regulate wireless signalling. The first resolution is to the effect that coast stations shall be obliged to receive and transmit all telegrams from and to ships at sea, without respect to the system. In order to facilitate such communication, all necessary technical information as to equipment shall be published, and precedence is to be accorded to messages relating to shipwrecks and to ships in distress. The first resolution also stipulates that tariffs are to be based as now, *plus* a special charge for the use of the wireless telegraph apparatus, all computed from the number of words, as agreed by the country to which the station ashore or afloat belongs. A second resolution provides that the wireless telegraph service shall be so regulated that the individual stations shall disturb one another as little as possible. These resolutions are reported to have been accepted by Germany, Austria-Hungary, Spain, the United States, France and Russia, with certain reservations in the case of the United States. The British delegates, with befitting prudence, decided to lay them before their Government. Italy, having already bound itself hand and foot to the Marconi system, is for 14 years prevented from exchanging telegrams with stations on other systems. The United States, on the contrary, is by law obliged to maintain the field open to all systems. Great Britain is in the happy position of being able to do as it pleases; there is, however, an agreement constituting a monopoly between the Marconi Company and the London Lloyds. We trust that the British Government will maintain this healthy condition of freedom, encouraging the development of wireless telegraphy by the same methods that have led to success in other applications of science to commerce, meanwhile assisting matters, if necessary, in cases of wilful annoyance of one installation by another, when it can be proved that the interference arises from malicious opposition, and when the opposition can be located.

The resolutions of the Conference strike us as being somewhat premature. It is too early in the day to lay down the law that all stations are to receive messages by all systems.

It requires at least another Berlin Conference to tell us how such *en tout cas* apparatus is to be arranged. And it requires yet a further Berlin Conference to inform us how, in the case of such a contract as that entered into by Italy, the apparatus is to be made selective or exclusive. Is it to be by codes or by nodes? The Naval Manœuvres this year have taught the Admiralty how impossible it is to pick and choose between wireless signals, and the experience at the yacht race has informed the world that not even the Marconi Company, with all its vaunted pretensions to syntony, can avoid being pestered by the signals of other installations. It will be time enough to legislate in regard to monopolies when the monopoly has justified its existence, and has learnt to build solid fences in place of what to-day are but flimsy hoardings, too weak even to stand up against the paste-brush of its own bill-posters.

The yacht race fiasco is especially instructive, and may well be taken account of by Governments, because the installations were erected, apparently, in good faith for commercial ends. It was not of the nature of a scientific experiment. We may, therefore, presume that if it had been possible, by arrangement of apparatus, to prevent mutual interference, this, for financial reasons, would have been done. The alternative would have been to introduce a little commercial courtesy into the battery solutions at the various stations; it is a salt which cannot be obtained by legislation, but it is an invaluable specific in cases of this kind. It is contemptible, even in commerce, to "queer another man's pitch." It is not playing the game. We suggest that, owing to the extraordinary conditions that govern wireless telegraphy, the difficulty of localising offenders, the unmatured state of the apparatus, the doubts as to the validity of patents, and the over-ruling urgency of messages from distressed vessels, legislation must needs wait. But in the meantime commercial courtesy might form an excellent substitute.

STREET TRAFFIC PROBLEMS.

The perpetual problem of street traffic is being perpetually resolved; it is not new in itself, although its aspects are changing always. Before ever there were any papers or Parliamentary Commissions we may be sure there was a street traffic problem just as there was a labour problem, a food problem, and a sex problem. Our requirements are ever greater than our facilities; or, as some would have it, when facilities are created to serve some latent need, the demand soon romps ahead of the supply. The supply of roads, or of litters, or sedan chairs, or mail-coaches, or electric cars has never yet satisfied the diabetic but immortal need of the people, and we hope the bad day of satiety will never dawn.

We are in a less happy position than the savage who sees nothing beyond the next cocoa-nut, and sees the way to it with perfect clearness, and knows that he need not worry about getting it till tea time; for we, being saturated with Board Schools and statistics, and panting, straining journalism, see into the next generation but one, and inevitably blur, or blot out, the perspective of our immediate future. That is why we become daily more panic-ridden, more driven by the devil of hurry in everything we do. We forget that, in this world, perfection is commercially impossible. A satisfied world would be a stagnant world. We are for ever tormented by the thought that our rate of increase is overwhelmingly greater than our rate of progress, and that a few years will see us involved in some kind of catastrophe unless immediate and enormous schemes are launched for our salvation. Modern means of communication and inter-communication have brought the whirr of the world's details to our ears, and our nervous system is always on the edge of hysteria except when it has fairly tumbled over.

Just now we are wearing ourselves out of a fit of nerves about the congestion of traffic in cities; and all that can be said, and written, and put on diagrams, for the next hundred years, has been said, and written, and drawn, during the last few hundred days, until the meanest man in the street talks, with an air of certainty and discrimination, about motor vehicles, shallow subways, and flying machines; or of the comparative merits of the various species of street tramways.

The housing problem, lately a panic puzzle, has been submerged by the traffic problem; even cleverly, and not too illogically, merged into the latter, the one made dependent on the other, and, luckily enough, producing two powerful bands shouting for each other.

Every day sees more people wanting to get from point to point a little more frequently, a little more comfortably, and a little quicker; and every day sees more people, with something over after buying their bread and butter, who turn it into trams, and tubes, and cabs and 'buses in the hope that it will be transmuted again into gold.

But to feel a want involves nothing more than an instantaneous mental process, while to fill it entails action in the concrete, with a corresponding passage of time. There is, therefore, a lag between the call and the coming, during which period the want is battening on itself and on any scraps of comfort which may be thrown in the interval, so that the pleasure of grumbling about inadequate travelling facilities never will be denied the human race.

There is no new problem to solve, there is only new material to work with given every now and then.

Of one thing the most timid investor may be quite sure, that there is ample scope in Great Britain for the champions of any conceivable system or method of traction, although over 50 millions have been spent on electric tramways alone already.

The field before the automobile is illimitable, and it may be found competing, in some improved and less expensive form than has been seen hitherto, with rail-guided cars; but it should be remembered that improvements will come also to the latter. Such competition can do nothing but good permanently, and it should be welcomed; but, before the competition becomes active, annoyance is likely to be caused by the perkily hostile attitude towards trolley roads assumed, since breaking through its shell, by the motor-car industry. Live and let live will be the cheapest and best policy just now, and it will be found that the hunting grounds of the automobile do not, as a rule, parallel existing tramlines, but extend them, surround them, and feed them, each becoming complementary to the other.

ELECTRICAL ENGINEERS AT ONE GUINEA EACH.

By T. CAMPBELL FUTERS.

There is an old proverb which says:—"A little knowledge is a dangerous thing"; but this is evidently not to be the case in electrical engineering, as anyone who aspires to become a member of this honourable and lucrative profession may do so by joining one of the correspondence colleges which have become such an educational feature during the past few years.

Such a college has been established in the North of England under the title of the "Northumberland and Durham Correspondence College of Electrical Engineering," and from a publication entitled "Electric Science and Art," issued by the College, we are informed that for a fee of one guinea anyone can become an up-to-date electrical engineer and obtain "lucrative employment by being able to run dynamos and motors, and to understand volt and ampmeters, the management of lamps and circuit connections. All this is the result of our instruction being original and absolutely without parallel in the methods employed for teaching electrical science, for when the course of the college is completed our students can, in addition to their ability to manage electric machines, originate inventions and improvements with such success as does not result from any other known system of electrical tuition."

"The course consists of 20 lessons, and a final examination for a certificate."

"'Electric Science and Art,' published monthly, treats of, and gives complete answers to, all questions that are of importance to students of electrical engineering," and also

contains a few testimonials from "Graduates of the College," one of which says :—"The learner is taken, step by step, and is taught clearly the basis of all electrical mysteries (to the man in the street). There is no jumble of words and meanings, as you get from text-books. Equations, both magnetic and electric, are simplified, so that an average schoolboy may understand them."

The value of the knowledge, however, may be judged from a few of the questions and answers; and one noticeable feature is that students may answer their own questions, for instance :—

"Question 3, and Answer. By J. Dick. What size of a dynamo would you select as the most economical for a steady output of *19 kilowatts of current?*"

"I would prefer a dynamo made to generate 20 per cent. more *potential of current* than what was required, as in this way, by slightly reducing the speed, the dynamo would not be overtaxed with resistance due to heating, while the required current would be obtained with *increased economy*. I would, therefore, put in a 23-KW. dynamo; for as 100 : 120 :: 19 to 22·8 or nearly 23."

In another answer :—"In the case of commutators for arc lighting dynamos, in which there are few segments, the insulation is provided by *air spaces* between the bars, about $\frac{1}{4}$ in. wide."

Evidently Mr. Dick might with advantage read one of the despised text-books, if only to learn the difference between "potential" and "current," as might another student, who speaks of "the *watts* of current." (The italics are the writer's.)

Questions 12, 13 and 14 are extremely interesting and useful, all asked and answered by the same student, who displays his great learning on compound winding :—

"What occurs with a compound-wound motor, when the load increases and the speed of the armature reduces?

"The current finds a path of reduced resistance through the shunt coils, and in this way prevents the heating of the armature coils, that are in series with the thin wire coils of the field magnet.

"Why is the thickness of the wire of the shunt coils on the legs of the field magnet of a motor twice or thrice the thickness of that of the wire of the series coils?

"The greater thickness of the wire of the shunt coils on the legs of the field magnet of a motor, is required for the extra flow of current through the shunt wire, when that of the series is arrested by the extra load on the current passing through the thin wire of series coils.

"Explain the mode of action of compound winding, by contrasting it with the mode of action of a steam engine when its load increases.

"When the load of a steam engine *increases*, the consumption of steam *reduces* and the *pressure* of the steam *increases*. If a safety valve was not used, the increase of the pressure of the steam would become excessive, when the speed of the engine was reduced by an increased load. In the same way, when the load on a motor *increases*, the consumption of current *reduces*, and the *E.M.F increases*, unless the field magnet is compound wound, for then the current that cannot advance through the series coils flows through the shunt coils, and in this way increases the number of the magnetic lines of force of the field magnet, until they balance the increased load." (The italics are the writer's.) Now, isn't that splendid!

Engineers in charge of steam engines will be interested in knowing that by increasing the load they will reduce their steam consumption. No text-books are required!

Question 18 is a sensible and useful question, especially in a mining district, but the answer is lamentable.

"What kind of plant would you put down to lift the following water with pumps run by electric motors? The water is situated in a dook or dip working, having an inclination of 1 in 3, and has a vertical head of 100 fathoms. The groth, or feeder, is 200 gallons per minute. It is proposed to make two lifts of 50 fathoms each, with three-throw pumps, whose plungers are 7 in. in diameter, and have a stroke of 8 in. State the size of dynamos, the engine and motors, and the current strength and electromotive force you would require?"

"If the actual feeder is 200 gallons per minute, I would erect plant for lifting 600 gallons per minute, to allow time for stoppages and repairs. If the efficiency of the electric plant is 60 per cent. that of the steam engine, and the efficiency of the pumps is 60 per cent. that of the power applied, the horse-power of the steam engine for running the two dynamos would have to be equal to $\frac{600 \times 10 \times 100 \times 6}{33{,}000 \times \cdot6 \times \cdot6} = 303$ H.P., and as at least 10 per cent. of the power of the steam would be lost in the engine itself $\frac{303}{\cdot9} = 336$, the total H.P. of the engine. The *potential* of the current to run one motor at the 50 fathoms lift should be $\frac{303}{2} = 151{\cdot}5$, or $151{\cdot}5 \times 746 = 113{,}019$ watts. As this pumping would be better done with an alternate three-phase current, the E.M.F. should be 2,000 volts, and the current strength $\frac{113{,}019}{2{,}000} = 56{\cdot}5$ amperes. This calculation supposes that *two* generators and two motors are used. In proportion to the feeder, the power has to be trebled, but this increase is not out of course. Each of the generators should produce a *current of 20 per cent. more potential* than that required to be given out by one of the motors." (The italics are the writer's.)

A current of 20 per cent. more *potential* is good! Further comment is needless.

Four other questions are interesting, inasmuch as they relate to an existing plant—presumably at a colliery—which reveals a state of things only too common when work is done without supervision, and on a cut contract.

"I attend to a motor made to work with a current of 500 volts and 140 amperes, supplied by a dynamo made for this output. Both the generator and the motor are compound wound. I find that when the load is on the motor the gauges indicate 500 volts and 130 amperes at the motor, and 110 amperes and 450 volts at the dynamo. The dynamo and motor only run for about 3½ hours in 24, and at the end of the time I find that the voltage has dropped 20 volts, and that the journals and coils of the field magnet of the dynamo have become hot, and the commutator becomes so hot that it would burn the hand if I touched it, but the motor keeps quite cool to the end of the time of running. Now, what I want to know is this: Is the difference shown by the gauges, the difference of potential at the brushes of the dynamo? Is it correct for the voltage to be higher at the motor than the dynamo; and if not, what would occur if the dynamo attendant was to speed up the engine to give 500 volts at the dynamo?"

"How does it occur that the voltage drops 20 volts after three hours' running, while the steam pressure remains the same? Is it unusual for the commutator to get so hot as to burn the hand; and if so, what is the cause?"

It would be interesting to see the answers to these questions, but it is quite evident it is high time this plant was overhauled by some competent engineer.

The following is from another testimonial :—

"The lectures you have sent have enabled me to do work which I could *not have done* without them. I have just finished making a small dynamo for a colliery, and fit the colliery up complete with an electrical plant, consisting of a shunt-wound bipolar dynamo, output 50 to 70 volts, 40 amperes, *made by myself*. A set of 27 E.P.S. second-hand cells, and a switchboard fit up with a Stanley patent volt and ampmeter, Neville's patent automatic cut-out switch for use with accumulator, D.P. fuses, and D.P. switch and a six-way charge and discharge switch, and about 20 16-C.P. lamps on the pit top, offices, &c., and 10 16-C.P. lamps at the pit bottom, and I have put about half-a-mile of overhead cable bare to the colliery owner's residence, and fit him up with 20 16-C.P. lamps, and this is a most satisfactory job." (The italics are the writer's.)

If this student did all this *without any other assistance*, it is very creditable, but—did he? Even at a large colliery it is questionable if there would be the necessary machines for making a dynamo. Moreover, it would be most interesting to know what this installation cost.

Whilst it is right for everyone to try and improve his position, and to acquire a knowledge of electrical engineering to aid him if necessary, it is absurd to suppose anyone can do so by merely studying, however well written, a course of 20 lectures on paper, which will enable him to design and

take charge of electrical plant. It is in this way the electrical profession is degraded, and incompetent and useless "electricians" swell its ranks. There is no royal road to electrical engineering any more than there is to any other profession. The worst of it is, probably 75 per cent. of those who do take the course in this college are connected with mining, and if by any chance the electrical plant is put in the charge of these "guinea" engineers, plants similar to that described in the last question will, no doubt, become general. Probably the worst feature is the granting of a certificate, which is, of course, not worth the paper it is written upon, as an educational guarantee, but which creates in the recipient an opinion of his knowledge and ability which is not warranted; and in all probability he has learnt just sufficient to make his "knowledge a dangerous thing."

PROTECTION: A REPLY TO MR. BYNG.

[COMMUNICATED.]

Now that the controversy arising out of my previous contribution has exhausted itself, I ask a little space for reply, and it will suffice to limit my remarks to Mr. Byng's letters. To reply fully would necessitate writing a book on Free Trade, so I will confine myself to the principal points. Mr. Byng prefaces his arguments by belittling his opponents, a method which, as I pointed out in my former article, is favoured by advocates whose case is inherently weak. "Lawyers who never pay wages themselves"; "so-called 'economists' and 'experts' who never imported sixpennyworth of goods"; "journalists who never produced anything but 'copy'" these are a few of the epithets flung at those who presume to hold an opinion differing from those of the Protectionist manufacturer. I will not follow him in this direction, but will touch lightly on those parts of his letter which are intended as arguments.

Consistency is not Mr. Byng's strong point. Thus, in one place, he says, "I have spoken, written, and agitated for Protection"; in another he says, "you who are a Free Trader, and I, a Protectionist, agree substantially on many arguments and facts. You grant that *universal* Free Trade is the ideal condition, yet we are receding further and further from that ideal condition." And again, "Take my advice, and do not play with the fire of Protection." One begins to think our author is a Free Trader in disguise, for how can a Universal Free Trader be, at one and the same time, an out-and-out Protectionist?

Not satisfied with claiming for himself to be both a Free Trader and a Protectionist, he endows me with the same dual qualities. This kind of inconsistency is, however, characteristic of the arguments throughout his letter.

Thus, "Free Trade is a religion, a fetish, a ghost. If adversity comes, you must still believe and say 'Allah is great'; yet, a few lines further on, comes the contradiction: "You have admitted many of its faults and disadvantages." If I admit its faults, how can I regard it as a fetish or a religion?

In one place he makes out that the foreigner dumps his stuff over here below cost price, and in another this is contradicted by saying that the foreigner always requires and gets good value, and "a good profit into the bargain."

Speaking of Retaliation—a point on which Mr. Byng misconstrues my meaning—he says: "Don't try to be a Retaliationist—it won't wash. You would be the laughing stock of the Germans and Americans more completely than you Free Traders are now." But what does his book say? On p. 199 we read, in italics, "*No nation without power of retaliation can possibly exist for any length of time among nations with protective tariffs*," and on p. 200, "This power of retaliation is the *only* weapon a nation has with which to compel a nation to lower its tariffs." And yet again: "England's very existence depends upon her regaining the power of retaliation." I am well content, therefore, to let Mr. Byng, of 1901, reply to the Mr. Byng, of 1903. But how can anyone argue with such a changeling? It would be almost as profitable to chase a "will o' the wisp." Before leaving this point, however, let me add that I said nothing about substituting the threat of retaliation for the real thing. That is Mr. Byng's interpretation. Nor does the word "retaliation" necessarily mean "imitation." Further, in the quotation "With what measure ye mete, it shall be measured," &c., the word "measure" means neither quantity nor length. It is not the quart pot nor the foot rule that is referred to. The word has a wider significance than "measurement."

It is just this confusion of terms, this mistaking of measurement for measure, money for value, exports for selling, and imports for buying that leads to fallacious conclusions.

There is a sort of automatic compensation—call it retribution, if you like—which is always at work; irresistible, irrepressible. Thus, whilst it is not a difficult task to show that some of our industries have suffered owing to foreign tariffs, we must not overlook the fact that, without any retaliatory tariff on our part, the Protectionist nations have lost industries also as a direct consequence of their own tariff; the net advantage remaining with us, the Free Traders. To instance only one case, the American Tariff Act of 1883 raised the duty on the fabric used in the manufacture of ruchings and rufflings from 35 to 125 per cent., leaving the duty on the finished article at 35 per cent. Prior to this time the American manufacturers supplied not only the American market, but exported largely to Canada, the West Indies and other countries. The 125 per cent. duty not only crippled the export trade completely, but led to such an importation of *British* goods that thousands of hands in America lost employment, and three-fourths of the manufacturers in that business were ruined. This is the sort of thing that always happens in every tariff scramble, and a perusal of the recognised trade journals to-day convinces us that inevitable ruin of many industries will follow if British Protection comes to pass. Well might Mr. Byng exclaim, "Don't play with the fire of Protection."

This principle of automatic retaliation or compensation is everywhere apparent, even in the most common-place events. It was impressed most strongly upon my mind last year when the excellent service of electric tramcars commenced running through Croydon into Purley.

Now electric trams are going to solve all sorts of social problems, and are looked upon rightly as a sure sign of progress. The working man is to be transplanted from congested and insanitary districts to cheap artizans' villas in the country, where he can breathe the pure air and look on green fields; where the lark, singing in the morning at Heaven's gate, will awake him in time to catch the first workman's car to town, and all that sort of thing. Well, the electric cars came, and the immediate result was that the thrifty housewife, who always buys in the cheapest market, took a penny car to Croydon every Saturday and brought in the week's stock of provisions, the Purley shopkeepers naturally suffering in consequence.

Here, from the Protectionist point of view, we have Croydon "dumping" its cheap surplus stuff in Purley. It has two markets, its own and Purley, and can afford to sell to Purleyites (on the production of a punched tram ticket) at a cheap rate, because of the increased quantity sold. What is the Purley shopkeeper to do? How can he retaliate? Can he ask that import duties be imposed on Croydon stuff, or that the trams should not come within a mile of the boundary, or that the authorities should compensate him for his loss of custom, and so on? He would be laughed at; yet the effect on his trade is the same as if the cheap provisions were imported from America or any other protected country. His sales fall off, and his rent goes up, because of the increased demand for houses. And there is not a Protectionist in the country who would lift a finger to help him, or who would think that he had any grievance.

And now, where does automatic retaliation step in? An increased demand for house property springs up in Purley; building is commenced, and houses rise as if by magic. The whole place in a short time is altered out of all knowledge. More trade is done, and even Croydon shopkeepers find it pays to open up branches there rather than rely on the trams for exports. And whereas a house can hardly be got "for love or money," hundreds of houses are now empty in Croydon, and rents in some parts are falling. It is but a commonplace illustration, and might apply to a hundred

localities; but the principle is there. Just a word in parenthesis in the ear of the Industrial Redistributor. The new houses, resulting from a cheap electric tram service, are not generally workmen's dwellings. The final effect will be to remove the well-to-do farther from, and the workmen nearer to, the factory or industrial centre. And now, leaving the country, with its cornfields, its woods, and larks, we must drop again from the contemplation of the sublime to the arguments of Mr. Byng. The next item in his programme is the "peace and goodwill" argument. It would not be very difficult to show that it was Protection that caused the war between England and the American colony, and that our trade interests prevented a war a few years ago; but it is more interesting to let the Mr. Byng of 1901 answer him of 1903.

Says the latter:—"Another favourite theory of the kindly Free Trader is that Free Trade will bring peace and good will amongst nations. Ever since we have had Free Trade England has been at war in some part of the world or other. . . . So much for the connection between Free Trade and peace and goodwill of other nations towards us." Now turn to p. 204 of "Protection," by the Mr. Byng of 1901, and read the inscription on the other side of the shield. "If Great Britain should exercise the right which every other country exercises, *the right of retaliation*, the penalty will be international complications, the rupture of friendly relations with foreign powers, perhaps WAR!

"Let no one dream of Protection unless he realise the risk to be run." The two Byngs, therefore—the 1901 and the 1903—cancel each other.

In his letter, Mr. Byng objects to the theory that goods exported are payment for goods imported. Such a theory, he says, "is fallacious, mischievous, and without common sense, as I will show." He does not show it, but with that kind of dogmatic assertion which passes for argument throughout all his writings, he says: "No sane man could bring such theories forward. We shut our eyes and open our mouths, and wait to see what the foreigners will send us." Sanity, indeed!

But, before attempting to controvert our friend's objection to the theory, let us again turn to this precious book of his and see if we can find further enlightenment on this vexed question. Yes; here it is. On p. 70 we read:—"If foreign nations send us goods they naturally require payment for them, and if we put the word export for payment, never mind in what form the payment is made, no doubt the theory that imports must be paid for by exports is true."

Having made this fatal admission, he seeks to modify it by attaching a special interpretation to the word exports; but if he will only grasp the idea that buying and selling in themselves are each only half of a transaction, a complete exchange of commodities—viz., the exchange of imports for exports—being the whole, he will simplify matters for himself considerably. There is no doubt he really feels, in his heart of hearts, that the theory is true, and he cannot help giving expression to this feeling. Truth, like cream, comes to the top. Thus, on p. 77: "Foreign countries needed our manufactures. We wanted their produce. We exchanged." He also realises that Protection, if it restricts imports and increases exports, is bound to impoverish a country, because, of course, exporting goods means sending wealth away, and importing means increasing the wealth of a country; hence we find Mr. Byng showing, on pages 79 to 81, that unless America relaxes her protective system, she will cripple her imports to her own detriment.

He is bound to admit this, in spite of himself, but will not logically pursue the argument, which would show that the nearer America approaches Free Trade, the better it will be for her, as it has been for this country.

The great stumbling block is in the confusion of terms brought about by the use of money, which, after all, is only a labour-saving device to enable traders to take the exchange how and when it best suits them. We speak of a successful business man as being rich, or getting rich; but when we come to think of it, this does not mean accumulating money. As fast as he gets money he exchanges it for stocks or property, land, &c., and in all but the smallest transactions he pays, not in money, but in goods, or stocks, or an equivalent. In fact, so long as the seller, to use a convenient word, obtains an equivalent—that is, money's worth—he does not care whether payment is in sovereigns, banknotes, or material.

Take an ordinary trade transaction. Suppose I order from Mr. Byng £100 worth of carbons (I could probably get them cheaper abroad, but I want to encourage home enterprise). First of all he asks Stubbs, or another of those convenient firms who find out everything about everybody, if I am worth the £100. On receipt of the carbons I don't pay 100 sovereigns. I don't possess them. I give a cheque for the amount, and Mr. Byng is entitled to £100 worth of stuff which I hold security for by reason of some half-dozen or so other cheques made out to me and entered up to my credit at the bank. I have never received the stuff, and don't want it. Its only use to me is that I can transfer it to someone else when I want something. So, Mr. Byng does not actually receive £100, but he is credited with 100 pounds' worth of wealth which, nominally, I possess, but which is really only guaranteed to me by half a dozen other people, and in turn guaranteed to them by six times half a dozen others, and so on. No one can say really how many people have had a hand in paying for those carbons. And after all we should simply say that £100 worth of carbons has been bought and sold. Now, if at the end of the year the cheques payable to me, exceed in value those made out by me to other people, I have made a profit. And why? Simply because my imports have exceeded my exports. I have no more money in my pockets, but my bank book tells me that I can go for a holiday, or obtain a motor-car, or a pianola, or some other luxury which some one holds ready for me whenever I like to send for it. On the other hand, if my exports have exceeded my imports, I have had a bad year, and some of the wealth I hold may belong to somebody else. This is all very simple and obvious, but it is extraordinary that what one accepts as true for the individual he rejects as inapplicable to the nation. But it is equally true. There are no such things as national imports and exports, except in so far as they are the sum total of individual transactions. Mr. Byng talks of shutting our eyes and opening our mouths to see what the foreigner will send us. But what nonsense all this is. Foreigners send us just what we individually order, as we send them what they individually order from us. If the stuff they send us exceeds in value what we send them, we make a profit, and not otherwise.

Mr. Byng, unwillingly, but necessarily, when he is honest with himself, admits that this is so in America's case; but he need not go to America for proof. Take only the case of Ireland. Was it Free Trade that ruined Irish industry, or was it Protection? What was the inscription on the cannon of the "Irish Volunteers" in the struggle for a removal of trade restrictions? It was "Free Trade or ——!" One part of Ireland has recovered from the throttling which Protection gave it, the other has not, as yet. The part that has recovered is Ulster, whose imports are considerable. The other parts, whose exports dwarf into insignificance the imports, are always on the verge of destitution, and if it were not for the fact that thousands of Irishmen cross annually to England to work in the English harvest fields, the destitution would be greater.

A country cannot constantly export wealth, receiving nothing tangible in imports, without impoverishing herself. But Ireland does not give her produce away, it is sent to pay for something, and right here we run our heads against something hard. What do the Irish exports pay for? RENT! Rent to landlords who add nothing to the wealth of the country, and who have probably never seen it, nor ever will. This, I take it, will not be disputed. Hence the value of produce exported, which eventually reaches the landlords, is not payment for labour or services rendered, but is a kind of toll or tax on producers for the use of something which Nature furnishes, but which the law of the land allows an individual to call his own.

(To be concluded.)

Penmaenmawr Lighting.—It has been decided to obtain an engineer's report upon the scheme for installing the electric light in the district.

CORRESPONDENCE.

The Need for a Good Economical Lamp.

We have recently been trying the Bohm lens lamp, with which we got 62 vertical and 10 horizontal C.P., consuming ·28 ampere at 200 volts.

A Nernst lamp tried under similar conditions gave 14 vertical and 11 horizontal C.P., consuming ·265 ampere. Both lamps were 10 ft. from the point the light was measured at.

The Bohm light is a pleasant primrose, practically the same as sunlight, and infinitely more pleasant than the sickly green of an incandescent gas mantle or the white glare of a Nernst lamp, and we should strongly advise your correspondent to try it. The cost is somewhat high (5s.), but not higher than the Nernst lamp, and we believe new filaments can be inserted when burnt out.

Lawrence & Co.

London, W.C., *September 3rd*, 1903.

Speed and the Public Safety.

Certain somewhat enigmatic remarks in your article under the above heading in your issue for August 28th appear to refer to the letter I addressed to the *Times* on August 8th, which letter was published in that journal not under mere initials, but with my full signature and address, as given below.

In this letter I pointed out that by most careful observations I had made opposite to my office in Victoria Street, I had ascertained that in some cases the speed of omnibuses amounts to the rate of 11 miles, covered vans 11½ miles, private carriages and coster carts to 12½ miles, hansom cabs to 12¾ miles, and bicycles to 16½ miles an hour, and all this in the middle of the day in one of the busiest streets of the metropolis.

I further went on to point out that, having regard to the above, should the proposed speed limit of 10 miles an hour be retained for motor-cars, these latter will be in the anomalous position of not being allowed to travel as fast as many other users of the road.

From your article I gather that the secretary of the Society of Motor Manufacturers has made use of these figures of mine, as, of course, he was very welcome to do, in a letter he has addressed to the London County Council. With the gist of Mr. Woodfine's letter I entirely agree, and I must confess that I am totally unable to understand your suggestion that a 10-mile-an-hour maximum limit of speed for motor vehicles in London would not considerably diminish the usefulness of such motors. Surely one of the chief advantages of motor traction is increased speed, and if motor vehicles are to be restrained from going even as fast as an ordinary lumbering omnibus, and if they are to be compelled by statute to travel much slower than vans, carriages, and cabs their utility will be materially impaired. This seems to me to be so obvious as to be scarcely worth arguing, and I can only suppose that between us there must be some confusion with respect to *maximum* speeds, which are what the Motor-Car Bill deals with, and *average* speeds, which are, of course, a very different matter.

I fear I must also disagree with your article on the subject of the comparative danger of tramcars and motor-cars. As to this, I am in accord with the Prime Minister, and will give a case in point.

Only a few weeks ago I was driving a motor-car at a very moderate speed along a road upon which tramrails are laid in the vicinity of Hampton Court. The tramrails had been watered, and on the greasy and treacherous surface thereby produced a bicyclist slipped and fell almost immediately in front of my car. The available distance was so short that to stop was impossible either for a motor car or still less for a tram car. Had it been a tram car that I was driving the bicyclist must inevitably have been run over, and probably killed, but not being restricted to any given path, I was easily able to deflect the course of my motor, and to avoid the prone cyclist altogether. That the tram car cannot deviate from a fixed path is in some cases no doubt an advantage, in others, however, it is equally an increased source of danger, particularly in the case of narrow roads where the tramways have to be laid on one side, and the ordinary rule of the road cannot be adhered to. Further, the tram-rails are in themselves—particularly when wet—a grave source of danger to other traffic, and more especially to cyclists. Indeed, it is to my mind a grave consideration whether the artificial watering of tram-rails should be allowed at all. No doubt it is advantageous to the trams in reducing friction, but it is a serious source of danger to other users of the road.

In conclusion, I note that you allude to a correspondence that has been published in a daily contemporary between a certain Mr. Albert Muntz and a correspondent who signs himself as "A. A. C. S."

May I say that I am in no wise concerned with the weight that the former gentleman—who is so prejudiced against motors that he would restrict them everywhere to a maximum speed of 12 miles an hour—attaches to my Victoria Street observations, while, as regards the latter, as I am informed by readers of the correspondence, "A. A. C. S." is quite able to take care of himself.

A. A. Campbell Swinton.

66, Victoria Street, Westminster.
September 2nd, 1903.

Smoke Abatement.

I have read with considerable interest the article in your current issue on smoke abatement. Having been until quite recently connected with a smoke-consuming company, I have had many opportunities during the last four years of seeing and testing various so-called smoke consumers.

Out of 10 different patents I have tested, eight were of no use, and two only fairly good. The reason of their non-success was, that they either admitted too much air, and at too low a temperature, and thus brought down the temperature of the unconsumed gases at the back of the bridge and made more smoke than ever, or else they admitted too *little* air with the same result.

The other two patents partially did what they were intended to do, and although the principle was correct, they were so elaborate in their construction (like a good many ampere-hour meters), and the cost of upkeep would be so considerable, that for every-day purposes they would be impracticable.

As regards forced draught, no one in his senses will admit there is any *real* economy in its use, or that it will prevent smoke; although one can burn with it a fairly cheap low grade fuel, one has to burn *more* of it. These cheap fuels (such as coke breeze) are not to be obtained at the same price as they used to be, owing to builders buying them for certain purposes. You may be getting more power out of the boiler by using forced draught, but are you doing the boiler any good?

Will it last as long? It stands to reason any kind of machinery, no matter what it is, if worked under undue pressure is doing it harm, and it will not last so long. Complete combustion cannot be obtained by forced draught, as the air in passing through the glowing carbon is deprived of its oxygen before it reaches the bridge, and smoke is produced.

As regards hollow bars, the great objection to them is the velocity of the air through the bars, caused by the pull of the chimney being so rapid that the air has not time to heat to the proper temperature so as to help combustion. The result is, it tends to lower the temperature of the gases at the back of the bridge, and thus causes more smoke, but, on the other hand, they are of some good, no doubt, as the fuel is not inclined to adhere to them as on ordinary bars.

Automatic stokers are minimisers of smoke (not consumers in the full sense of the word), as only allowing a little coal on at a time, there can be but little smoke, but if the boiler is pressed for steam, and a little more coal goes on than what it will take, smoke is produced at once.

My idea of an efficient smoke consumer would be to bring in highly heated air to the back of the bridge by means of a pipe from the front of the furnace, at such a high temperature that it would chemically unite with the volatile carbonaceous gases when they are at a high temperature, and thus get a better combustion. The difficulty, of course, would be to get the air in hot enough, and to get a thorough

good mixture. I have seen this attempted by means of vertical pipes placed immediately behind the bridge. This is impracticable, as the first time the stoker should happen to put his rake over the bridge down would go the pipes.

One must always remember the varying conditions that boilers work under; a sluggish draught, class of fuel used, whether the boiler works under normal conditions or not, the height of the chimney, the class of boiler, water-tube or otherwise. There is no hard and fast rule, that because a smoke consumer has been fixed on a certain boiler, therefore it would necessarily be of the same use fixed on another boiler, worked under totally different conditions. This is a fact that is too often overlooked.

I am afraid, Sir, this letter will draw the wrath of many makers of smoke-consuming apparatus, and I shall be subjected to much abuse, but my object in writing is not to abuse them, but to point out to station engineers, both present and future, the difficulties they have to contend with, both as regards economy in working of boilers and the prevention of smoke, also to guard them against the various appliances they will have thrust at them; "nine-tenths," as you say in your article, are of no good.

The smoke question is a very difficult one to solve, and I think you will agree with me a most *important* one, affecting everybody, as we cannot keep well if we have to consume smoke in our lungs.

What is the good of fining steam users for creating a smoke nuisance if we cannot show them the remedy?

E. A. S. Daniell.

Carnaby v. Neale and the South-Western Electrical Co.

We should be glad if you would insert on behalf of our clients, Mr. George Neale and the South-Western Electrical Co., Ltd., a correction of your report of the case of "Carnaby *v.* Neale and the South-Western Electrical Co., Ltd," in your issue of to-day's date, as the report does not fairly represent what took place.

It was admitted that at the date of the last balance-sheet, namely, May 31st, Mr. Neale's capital in the business was in excess of that of Mr. Carnaby, but that subsequently a further sum of £300 was found by Mr. Carnaby. The South-Western Electrical Co., Ltd., purchased the business of Messrs. Neale & Carnaby as from August 1st, taking over all assets and liabilities, and have paid or tendered the purchase money to the partners, but Mr. Carnaby refused to accept payment of his share. The £300 paid by Mr. Carnaby was one of the liabilities which was taken over by the defendant company, and was included in the schedule of debts which the company agreed to indemnify the vendors against.

Mr. Justice Walton stated that, Messrs. Neale & Carnaby having sold their business to the defendant company, who had taken possession, he would make no order for the appointment of a receiver, and that it was not Vacation business. The motion was consequently formally adjourned till the next sittings.

Savory Pryor & Blagden.

The Outer Temple, 222, Strand, W.C.

Ramsgate Tramcar Accident.

"Air and Sand's" letter in last week's issue is an excellent example of the gentle art of over-statement. As the letter might mislead engineers who have not an expert knowledge of the brakes in question, I trust you will afford me the opportunity of a reply.

The statement, "The evidence clearly showed that a magnetic brake requires to be supplemented by the hand-brake for stopping a car on an incline, because as soon as the car slows down the source of the magnetism is annihilated," was dealt with in part in my former letter. The hand-brake is not required to help stop a car on an incline, and the source of magnetism is not annihilated until the car has actually stopped; then, if the grade is very heavy and a stop of considerable duration is required, the hand-brake is applied. At service tests made on the Leeds Municipal Tramways, a heavy car on a 1 in 10 slope was held absolutely steady by the magnetic brake alone for from 10 to 30 seconds, after which it proceeded down the grade very slowly in 5-ft. steps, with 10 to 30 seconds between each, being caught up each time cup and ball fashion by the brake.

Again, magnetic brakes are stated to require 200 amperes and more, where the working current of the motors averages 10 to 15 amperes. The maximum current required by the motors to operate the Westinghouse magnetic brake, stopping a 10-ton car running at 15 miles an hour, inside 20 ft. with sand, and inside 30 ft. without sand, is about 30 amperes.

"Air and Sand's" remarks concerning the relative severity of railway and tramway brake service bespeak a very cursory consideration of the subject. Has it occurred to "Air and Sand" that for one stop made by a railway train, a tramcar in city service makes, probably, 40 or 50 stops? and that while one air pump on a railway suffices for a whole train of, say, 10 or 15 carriages, every tramcar must have its individual compressor, which is in almost continuous action? The actual braking mechanism of a railway carriage is not necessarily more complicated than that of a tramcar, while the absence of the compressor makes it in reality far simpler. Tramway braking conditions are much the more trying of the two, and the result of this is the high maintenance cost of pneumatic tramway brakes alluded to.

With regard to the combined track and wheel-brake operated by air, such a mechanism was fitted to one of the Manchester Corporation cars, and underwent a series of tests in competition with numerous other brakes. These tests resulted in the adoption of the Westinghouse magnetic brake.

Statements so easily refuted as those quoted above only weaken the case for the pneumatic brake for ordinary tramcar service. The air-brake has its distinct field of application, in which it is supreme, but it fails in competition with a brake which gives, under all conditions, the maximum possible retardation effect. British engineers who have studied this matter have given their decision, in almost every case, in favour of the magnetic brake, and much more "damaging disclosures" (*sic*) than those of "Air and Sand" would be required to reverse this decision.

Norman D. Cameron.

September 7th, 1903.

A New Form of Friction Clutch.

Being away from home, I have not seen before your editorial comment in your issue of August 21st, page 319, on the above paper recently read at Leeds.

I think your criticism in connection with the power question is quite justified as the statement now stands. I should have said the slipping under load would not answer when there is to be no sensible loss of power—not "when the power is to be *increased*." I shall put this matter quite clear in the final printing of the paper.

I thank you for the suggestions in your article as to the applications of the clutch, and may say, as indicating the correctness of your views, that the company now manufacturing the clutch has just secured an order in connection with the driving of printing presses, one of the most exacting of drives.

H. S. Hele-Shaw.

Hele-Shaw Patent Clutch Co., Ltd.,
Liverpool, *September 7th*, 1903.

English Porcelain Insulators.

I think it would be advisable, before Mr. John T. Harris accuses other people of not knowing what they are writing about, that he should make quite sure that he is not in that predicament himself.

Telegraph insulators, of which Mr. Harris speaks, have nothing at all in common with the class of porcelain to which I referred, viz., that used for overhead electrical transmission lines at high pressures (10,000 to 40,000 volts). This latter work demands special material, and such insulators have not yet been made, as far as I am aware, by any English pottery. I think I am in a position to know what

kind of porcelain is procurable in England, and I have tested samples from many makers.

It would conduce to a clearer understanding of the matter if Mr. Harris would explain what he means by the "galvanometer test;" also, how the testing voltage of 250,000 to 900,000 volts was procured, how it was measured, and how long it was applied.

I should be very glad to witness the tests Mr. Harris proposes, and would also be pleased to receive some samples from the pottery Mr. Harris indicates, so that I could test them myself. I would suggest that the results so obtained should be published in the Electrical Review, as they would doubtless be of great value to many readers.

Charles C. Garrard.

Hollinwood, Lancashire,
September 4th, 1903.

[We have received from Dr. Garrard a further letter on this subject, too late for insertion.—Eds. Elec. Rev.]

The Calculator Board.

Your kind encomium as to the merits of the calculator board has been corroborated in letters addressed to me from various parts of the country, also from France.

With your permission I will, when other work permits, soon supplement the first article on the above subject by a further one: "Practical Examples with the Calculator Board."

Edward Raymond-Barker.

Wimbledon, *September 9th*, 1903.

The Garuti Process.

We have read with interest the article which appeared in your issue of the 28th ult., describing the Garuti process for the production of hydrogen and oxygen by the electrolysis of water. As far as can be gathered from this abridged description, the essential feature of the Garuti process lies in the adoption of iron diaphragms for the separation of the evolving gases.

We would mention, however, that the employment of iron septa in this connection is by no means of recent origin, as this method of separation was first successfully adopted by us some 10 years ago, and received protection under our Patent No. 11,973 of 1893, a copy of which we have the pleasure to enclose.

It will no doubt be of interest to your readers to know that our patent system of water electrolysis has met with complete success, and has been used continually for the production of gas for military balloons since 1897, the purity of the electrolytic hydrogen being much appreciated. We have erected two installations at one military station, the larger installation being alone capable of producing 18,000 cb. ft. of gases per 24 hours.

It is not necessary for us to enlarge upon the manifest importance of securing, for ballooning purposes, a gas having the highest degree of purity and entire freedom from the destructive action upon balloon fabrics observed in the use of hydrogen manufactured under the zinc-acid process.

Economy of labour and material, as well as simplicity and cleanliness, have also been established as some of the further advantages derived from this system of gas production.

Siemens Bros. & Co., Ltd.
Alfred Sabine, *Secretary.*

Westminster, S.W., *September 8th*, 1903.

Switchboard Attendants are Cheap To-day.

I have read with interest the articles that have appeared in your journal with reference to the salary of switchboard attendants—10s. per week is certainly low; but I think the average switchboard attendant gets as much as he is worth. From time to time there has been a good deal of discussion about the pay of shift engineers, and the staff of a central station generally, and I think it is a question that deserves attention.

On the one hand, the engine-room staff work all days in the year, and the times of other people's holidays are the busiest times for them; but, on the other hand, how many of those who constitute the staff are really qualified for the posts they occupy? I know for an actual fact—as your correspondent of last week states—that a good many are "jumped" into berths they have no right to occupy, and I could cite several cases where men occupy posts as shift "engineers" who have never even served any apprenticeship, and have never seen an engine before going into a station. In the case of a switchboard attendant it is different—no previous training is really necessary.

However, while chief engineers can get these men to run a station for them the pay will always be low.

H. T.; C. C.

Refuse Destruction and Power Production.

I have read with much interest your leading article upon this subject in your issue of September 4th. I am entirely in accord with your statements that the province of a dust destructor is the complete destruction of refuse, and this being so, it is obvious that a refuse destructor would not be put down in any given neighbourhood unless it were for the purpose of disposing of the refuse. On the understanding, then, that a refuse destructor is a necessity, I find the line of argument adopted in the latter part of the article somewhat confusing, as you there proceed to compare the cost of stoking a destructor with the cost of stoking boilers with coal. If the steam generated by the destructor can be utilised for electricity purposes, it seems obvious that the cost of stoking to the electricity department is nil so long as the boilers connected with the destructor are capable of supplying all the steam required by the electricity works. It is just this fact, that the stoking of the refuse has to be done whether the steam generated is used for electric lighting purposes or not, and that the steam obtained is a bye-product, that makes the combination of a dust destructor with electricity works an economical arrangement in many cases. Other advantages of the combination in properly designed and managed works are a reduction in capital expenditure on the joint works, and an annual saving in establishment expenses. There may be unfavourable conditions which, to a large extent, outweigh the advantages, and it is this which makes it impossible to state generally that the combination is, or is not, advantageous; every case must be considered on its merits.

W. P. Adams.

London, E.C., *September 8th*, 1903.

Electric Rock Drills.

With reference to Mr. T. Campbell Futer's letter in your last issue, we should be pleased to obtain permission for him, or anyone else interested in the subject, to see an installation of our drills in daily operation in a limestone quarry working nine-hour shifts. The plant is handled by the ordinary men employed in such a quarry, who have, of course, no electrical knowledge whatever. We would not for a moment suggest that "motor-driven" drills could be successfully operated under such conditions.

The Sandycroft Foundry Co., Ltd.

Chester, *September 8th*, 1903.

Corrosion of Bare Overhead Wires.

In a seaside town, where the current for electric lighting is carried by overhead conductors—some bare copper and some with the ordinary aerial covering—the conductors are found to corrode, and, in time, to break. This invariably occurs on the positive conductor. The conductors are run on porcelain insulators, fixed to an oak cross-arm. Positive and negative conductors are run on the same cross-arm, and are a distance of 2 ft. apart. The conductors are secured to the insulators with tarred string, in preference to wire seizings, in order to keep clear of electrolytic action; but, even with the tarred string seizings, the wires corrode and break at the point of seizure.

I would be very pleased to hear, through your "Correspondence" column, the cause of this corrosion on the conductors, and the best way to prevent it. Perhaps some of your readers know of similar cases.

The pressure is 200 volts, and the conductors are alive continually. Owing to the town being on the sea, the air is always charged with a certain percentage of salt.

Werdna.

Determination of Iron Loss and Friction.

In the method outlined below, but three single observations are necessary in order to determine the law of the friction plus iron losses for any frequency. For a given voltage applied to an unloaded motor, the speed and the watts necessary to overcome iron loss + friction are noted, and then with *field on* and armature circuit opened the time is noted that the motor takes to come to rest. These three observations are sufficient to determine the law of friction + iron loss as a function of the revolutions or frequency. To separate the friction from the iron loss, however, another set of three observations is necessary. The watts to maintain the motor unexcited at any particular revolutions or frequency are measured, and the time it takes for the motor to come to rest after an external turning moment has been taken from it. The method depends upon a predetermination of the moment of inertia of the type of motor or generator under consideration, and once determined the method should serve as a very quick test-house means of checking design.

Let the no load watts necessary to overcome friction + iron loss (after subtraction of calculable copper losses) be $= a\,\omega^x$, that is—

$$w = a\,\omega^x. \qquad (1)$$

Where w = watts, a is an undetermined constant, ω is the frequency, and x an undetermined index.

Let $w = a\,\Omega^x$ be the no load watts measured when the motor is running at the beginning of the experiment, and let Ω be the observed frequency, then

$$a = w\,\Omega^{-x}.$$

Now torque $= \frac{\text{watts}}{\omega} = a\,\omega^{x-1} = -I\frac{d\omega}{dt}$, where I is the moment of inertia. Determining the primitivi of the equation,

$$a\,\omega^{x-1} = -I\,\frac{d\omega}{dt},$$

and observing the limits $\omega = \Omega$ when t = time $= 0$, and $\omega = 0$ when $t = T$ = time the motor takes to come to rest after the armature circuit has been opened, we obtain—

$$\int_0^{\Omega} \omega^{1-x}\,d\omega = -\frac{a}{I}\int_T^0 dt,$$

and $\frac{\Omega^{2-x}}{2-x} = \frac{a\,T}{I}$, and observing that $a = w\,\Omega^{-x}$, we have

$$x = 2 - \frac{I\,\Omega^2}{W\,T},$$

and

$$w = W\left(\frac{\omega}{\Omega}\right)^{2-\frac{I\,\Omega^2}{W\,T}} \qquad (2)$$

We thus see that a and x have been eliminated. In separating the friction from the iron loss, the motor under consideration can be run at the given speed with fields *unexcited* by using a subsidiary motor, which can be instantaneously uncoupled from it after observing the watts necessary to run the subsidiary motor alone; the difference, of course, being that necessary to maintain the motor under consideration at the speed given. The same formulæ (1) and (2) would be applied, the difference between the watts observed on the two different runs giving the law of the iron loss alone, which, of course, can again be expressed as the frequency to some constant index with a sufficient degree of accuracy.

A. Press,
B.Sc. Cooper Union, N.Y.. U.S.A.

BUSINESS NOTES.

Battersea Polytechnic.—The session opens on September 28th. Particulars of the courses and classes are given in an advertisement appearing in this issue.

Electrical Wares Exported.

Week ending Sept. 9th, 1902.		Week ending Sept. 8th, 1903.	
Amsterdam	Value £117	Adelaide	Value £206
Bombay	75	Alexandria	46
Bremen	107	Amsterdam	20
Buenos Ayres. Teleg. mat.	206	Antwerp. Elec. Fuses	325
Calcutta	381	Auckland	135
,, Teleg. cable	163	Bombay	21
Cape Town	586	Boston	23
Christiania. Teleg. cable	400	Calcutta	3,885
Colombo	282	Cape Town	340
Copenhagen. Teleg. mat.	284	Coronel	42
Demerara. Teleg. cable	160	Dunkirk	140
Durban	251	Durban	1,168
East London	295	,, Teleg. mat.	155
Fremantle	146	East London	1,335
Gothenburg	20	,, Teleg. mat.	563
,, Teleph. cable	523	Gibraltar	16
Lisbon	35	Hamburg	25
Malaga	74	Hong Kong. Teleg. mat.	23
,, Teleg. cable	102	Lisbon Teleph. cable	60
Melbourne	660	Maceio	33
Perth	65	Madras	246
Rosario	62	Melbourne	36
St. Petersburg. Teleg. mat.	820	Pernambuco	44
Shanghai	351	Perth	419
Singapore	4	Port Elizabeth	55
Stockholm. Teleg. cable	598	Rangoon	158
Sydney	556	Rotterdam. Teleg. mat.	40
Valparaiso	100	St. John, N.B.	52
Wellington	48	St. Petersburg	307
		Shanghai	119
		,, Teleg. mat.	32
		Singapore	117
		Swimam	50
		Sydney	528
		,, Teleg. mat.	393
		Townsville	160
		Yokohama	21
Total	£6,971	Total	£11,430

Foreign Goods Transhipped.

Bombay. Elec. goods .. Value £62 | Ostend. Elec. goods. .. Value £88

G.E.C. Sports.—The seventh annual sports of the Peel Works of the General Electric Co. were held at Belle Vue Gardens, Manchester, on Saturday, August 29th, before a crowd of about 8,000 or 9,000 people. The weather was fortunately fine, and the sport distinctly good, in fact, far above the average of works sports. The finish of the cycle race and the sprints both in heats and finals were very close, showing that the competitors had been very carefully handicapped. The final of the 220 yds. flat race, for which the president (Mr. Eckstein) presents a cup which is won outright each year, was won by C. Oakley, who ran through from scratch in the remarkable time of $23\frac{2}{5}$ seconds. During the afternoon the band of the Salford Police played selections, and at the conclusion of the races Mrs. Eckstein kindly presented the prizes to the successful competitors; after which Mr. Brooker, as chairman of the committee, proposed a vote of thanks, which was carried unanimously.

Trade Announcements.—Messrs. Redpath, Brown and Co., Ltd., steel girder builders and constructional engineers, of Edinburgh and Glasgow, have opened extensive works at Riverside Works, East Greenwich. They will be in a position to deal rapidly with all classes of structural steel work, and have begun with a stock of about 3,000 tons of the constructional sections most largely in demand. All of the company's works (at which, by the way, stocks of 10,000 to 12,000 tons are always held) are equipped with up-to-date electrically-driven plant.

Owing to rapid increase of business, the Electrical Trades Supply, Limited, has removed to larger premises, having built new works, warehouses and offices, at Britannia Works, Great Charles Street, Birmingham, to which address all future correspondence should be sent. The new factory is equipped with the latest labour-saving machinery for the manufacture of switches, switchboards, fuses, fuseboards, circuit-breakers, starting switches, and fittings of all kinds. There is extensive warehouse accommodation, so that a large stock of wiring accessories and fittings will be kept. The company is agent for the British Insulated and Helsby Cables, Ltd., and Messrs. Drake & Gorham, Ltd.

Messrs. Oliver, Clark & Co., owing to the great increase of their business, have taken larger premises at St. Mark's Road, Notting Hill, W., where they have established workshops, offices and showrooms, with facilities also for repairing and charging motor-cars. Besides large contracts for local authorities, the firm has in hand the wiring of blocks of 180, 200, and 100 houses respectively.

Automatic Signalling on the District Railway.—In consequence of the heavy rains of last week, the electrified portion of the District Railway was flooded in two places. The water partially submerged the running and negative rails. In spite of this, however, we are informed that the track circuits of the Westinghouse automatic signals, with which this line is equipped, were not in any way affected, and the trains were signalled without a hitch.

London Motor Omnibus Syndicate, Ltd.—Before Mr. Justice Walton, sitting as Vacation Judge on Wednesday, the petition of Mr. A. McBain for the compulsory winding-up of the London Motor Omnibus Syndicate, Ltd., was down for hearing. Counsel for the petitioner said it had been arranged between the parties that the petition should be withdrawn on terms agreed upon. His Lordship accordingly dismissed the petition.

Bolton Top Cover for Electric Cars.—We illustrate a Bolton type of top cover for tramcars, which has recently been built by Messrs. Milnes, Voss & Co., of Birkenhead, to the designs of Mr. A. A. Day, chief engineer to the Bolton Corporation tramways. The seating capacity of the top deck is not in any way decreased, in fact, in the example which is now running seating capacity for four more passengers has been obtained. The cover is not a totally enclosed one, it being optional for a passenger to be inside or outside under cover. This enables the top to be utilised either in wet or fine weather, and also enables the design to be made to look less heavy, or, perhaps, rather less top-heavy than a cover covering the full length of the car. The facility for getting in or out of the fully enclosed part is also much greater than in the case

Bolton Top Cover for Electric Cars.

of the fully-covered top cover, some of the latter being very awkward to enter and leave. There is in this case fully 6 ft. of head room, enabling a tall man to stand upright on the top deck; this, however, is rather a matter of the lowness of the bridges under which the top cover has to pass. The Bolton Tramways Committee are so satisfied that it meets the requirements of the public, that they have already sanctioned the fitting of 12 more cars with this cover, and it is confidently believed that the adoption of such a cover, which does not hinder the use of the top deck in fine weather, and makes it available in wet weather, will realise considerably increased traffic receipts.

Switzerland.—An important project is at present under consideration, viz., that of constructing an electric railway up Mont Blanc. The projected line would be 12 km. long and have five stations; it would be worked partly as a cable railway and partly on the rack-rail system. Water power would be utilised in the generation of the necessary electrical energy.

Electric Power in Paper Mills.—A contract was recently obtained by the British Westinghouse Electric and Manufacturing Co., Ltd., for the electrical driving of the mills of the Donside Paper Co., Aberdeen. The plant will include one Babcock and Wilcox boiler, fitted with chain-grate stoker, superheater, and economiser, which will supply steam at 200 lbs. steam pressure to a Browett & Lindley triple-expansion engine. This will, in turn, drive a 375-kw. Westinghouse double-current generator giving, on the alternate current side, three-phase current at 220 volts, 25 cycles per sec., and, on the direct current side, current at 125 volts. Continuous current will be used for the variable-speed motors, of which about 75 kw. will be installed. All other motors will be of the Westinghouse polyphase induction type. These will include five 50-h.p. motors for the beaters and breakers, one 35-h.p. for driving a Marshall breaker, and three smaller motors driving the starching plant and edge runners. One 75-h.p. variable-speed motor will drive the dry end of the paper-making machine, and a 30-h.p. motor the wet end. In addition to these, all the pumps will be electrically driven, as will also the finishing house, ink grinders, and so forth. It is anticipated that electric driving will effect a very large economy in coal consumption, and a further consideration, which has, no doubt, proved of much importance in this case, is the flexibility of electric as compared with mechanical driving, in view of certain extensions contemplated in these mills.

Electrical Exhibition.—The E.L. Committee of the Eastbourne T.C. has recommended that an exhibition of electric fittings, &c., be held in the Town Hall, Eastbourne, during the autumn. The borough electrical engineer (Mr. J. K. Brydges) has been requested to make the necessary arrangements for exhibits by firms engaged in the manufacture of electric light fittings.

Auction Sale.—On Tuesday, September 22nd, Messrs. Percy Huddleston & Co. will offer for sale a stock of electric supply stores, of which some details are given in our advertisements to-day. The sale takes place at Hammersmith, under the liquidation of O. Berend & Co.

Catalogues and Lists.—Mr. G. Braulik, of Upper Thames Street, E.C., has issued a list giving particulars of his "Eclipse" electricity meters of several types, such as are being used by some of the London electricity supply companies and committees. The meters are suitable for use on both alternating and continuous current circuits, single and polyphase.

A new catalogue has been received from the Zurich Incandescent Lamp Co., of 47, Victoria Street, S.W., in which prices and natural size illustrations appear of "Stearn" high voltage lamps, single and double filaments, fancy types, low-voltage tramway, miniature and candle lamps.

Some notes and testimonials respecting the Codd arc lamp are embodied in a new six-page list issued by the Codd Arc Lamp Co., Ltd., of Standard Works, Dame Agnes Street, Nottingham.

A price sheet of Brockie-Pell arc lamps (enclosed) has been issued by the Brockie-Pell Arc Lamp, Ltd., of Worship Street, E.C.

A circular relating to the Partridge self-lubricating carbon brushes of several different grades for motors and dynamos, has been sent out by Mr. C. R. Heap, of Westminster.

Messrs. Bergtheil & Young, of Camomile Street, E.C., have published a price list (No. 18) of their "B. & Y." continuous current motors, of sizes ranging from $\frac{1}{10}$ h.p. to 13 h.p., (open protected, ventilated enclosed, and entirely enclosed). Another circular (No 10) details the "Bandy" electric fans and ventilators for bracket, ceiling and table use. Both lists are well arranged with good illustrations, and the essential sizes, capacities and prices are tabulated.

The latest addition to the excellent set of pamphlets which are being issued by Messrs Siemens Bros. & Co., Ltd., is entitled "Telepherage in Goods Yards." A description and some interesting illustrations are given of an electrically-operated system for removal of goods from railway trucks to warehouses, and transference of goods to other conveyances for reloading or local distribution. The advantages of this over other systems are stated briefly, and electrical engineers and others who have at times to advise railroads, steamship companies, dock companies and owners of warehouses, should study the contents of the pamphlet.

A small folding card has been placed in circulation by the Sunbeam Lamp Co., Ltd., of Gateshead-on-Tyne, in which are given some hints for electric light users respecting the overhauling of lamps. The necessity for dusting, abandoning lamps when they discolour, the use of lamps of proper voltages, switching off lights when leaving a room, and other matters which it is necessary for the consumer to know in order to get a good lighting effect at a low cost, are briefly stated. The Sunbeam Lamp Co., owing to largely increased output, is again offering reduced prices for quantities.

The Phillips Machine Syndicate, Ltd., of Salisbury House, London Wall, E.C., has issued a small well illustrated pamphlet of 20 pp., on the "Care of Commutators." It embodies a description of the Phillips commutator truing machine, with which most electrical engineers, we believe, are more or less familiar. The machine has, we learn, been adopted by the Government offices, municipal authorities, and leading electrical manufacturers.

A new catalogue of continuous current motors of the "R.E." type has been issued by the Rhodes Electrical Manufacturing Co., of Bradford, and Bishopsgate Street, E.C. It contains a detailed specification, together with neat half-tone pictures of parts of the motor, dimensions and prices being quoted in tabulated form. Prices of R.E. type generators from 1 to 24 kw. are also given.

Two new publications, attractively prepared as usual, have been issued from the press by Messrs. Holden & Brooke, Ltd., of West Gorton. No. 40 is devoted to exhaust steam injectors for boiler feeding, heating, raising and circulating water, heating buildings, &c., by means of exhaust steam. No. 41 describes lifters and ejectors for lifting or forcing to a height, conveying long distances on the level, mixing or extracting liquids, semi-liquids, or gases.

We have received from Mr. R. W. Paul, of 68, High Holborn, London, W.C., a catalogue of electrical testing instruments, comprising all kinds of resistance boxes and coils for small and large currents, bridges, potentiometers, moving-coil galvanometers and other types, insulation testing and fault localising sets, electrostatic voltmeters, &c. Some of these instruments—especially the moving-coil galvanometers, with the coil suspended on a single pivot—are so interesting that we shall devote some space in our next issue to a detailed description of them.

Electric Tramways Trust, Ltd.—In the Vacation Court, before Mr. Justice Walton, in the High Court of Justice, on Wednesday, the petition of W. Bratley for the compulsory winding-up of the Electric Tramways Trust, Ltd., came on for hearing. Mr. Mulligan, K.C., who appeared in support of the petition, said the company was registered in December, 1900, and it was now in voluntary liquidation. The petitioner was a creditor for a considerable amount, for which the company had given bills. Mr. Bramwell Davis, K.C., for the company, said a compulsory order would be of no value, as there were no assets. His Lordship granted a supervision order, with an additional liquidator.

Annual Outing.—About 45 employés of the Wolverhampton and District Electric Traction Co. had their annual outing on September 1st, journeying by special car from Bilston to Dudley, thence by saloon carriage on the railway to Kidderminster, where another special car was in readiness to convey them to Stourport, dinner being prepared on arrival at the Old Crown Hotel. Afterwards the boat, *Lady Honor*, conveyed the party to Holt Fleet and Worcester. The following day the remainder of the employés, to the number of 50, had a similar outing.

(*Continued on page* 427.)

OVERHEAD TRACTION FOR ROAD VEHICLES.

The Stoll System.

Our readers need no reminding that the proposal to run electrical omnibuses and motor-cars from overhead trolley wires, with the existing roadways as the only permanent way, has lately been very much to the fore. Parliamentary sanction has been granted to such a line of "tramways" to be worked in the county of Gloucester. There is little reason for doubting that before very long we shall be spared the necessity of going to the Continent to find practical examples, but shall have them in our very midst. The matter possessed more than usual interest when Parliamentary Committeemen were considering it, because the very large question was raised whether other parties, presumably tradespeople and other owners of private electrical vehicles, could be allowed the use of the overhead conductors on certain terms and conditions.

In view of the interest which is thus aroused, we think that it may be timely to give a description of the Stoll electric omnibus system which has, we learn, been working successfully in Germany for some time past, and has been taken up by the Allgemeine Electricitäts Gesellschaft, of Berlin.

The advantages of a system of overhead traction in which rails are dispensed with, are obvious. The first cost of such an installation is very much less than that of the ordinary electric tramway with rails, and the power consumed per seat is only about 25 per cent. greater. In suburban and country districts where the amount of traffic is too small to pay for the laying down of a tramway, overhead traction applied to vehicles running on ordinary roads would appear to have a great future before it. Fig. 1 gives a general view of the Stoll system, and represents part of a three-mile line near Dresden. The great simplicity of the system is at once obvious from this and the other accompanying illustrations. From masts with brackets are suspended by means of insulators the overhead conductors, which are double, because, owing to the absence of rails, one of the conductors is required to take back the current. The distance between two masts upon straight parts of the road is about 35 m.; at curves the distance is less.

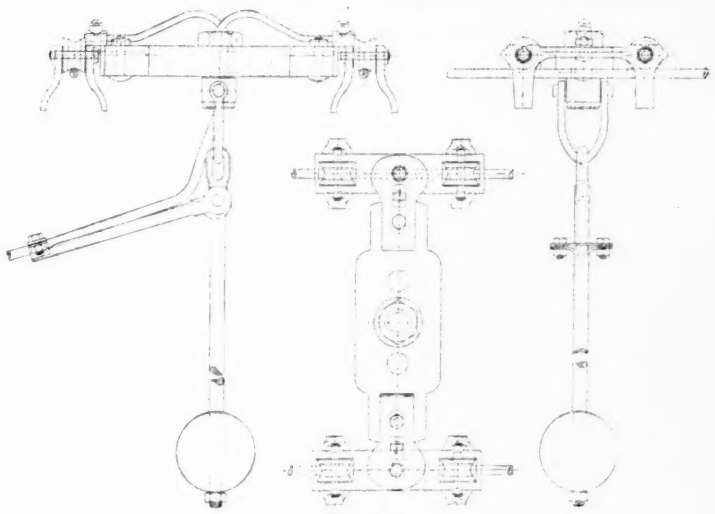


Fig. 2.

The masts are about 8·3 m. in height, so that the conductors can be suspended 6 m. above the surface of the road.

The overhead conductors are usually of hard-drawn 8 mm. trolley wire, with a tensile strength of 40 kg., and a conductivity of 97 per cent. of standard copper. The two conductors run at a constant distance of 30 cm. from each other, and are suspended by the brackets at a distance of about 3 m. from the masts. The insulating material used is "stabilit," which has a high resistance, great strength, and is very slightly hygroscopic. At each 1,000 m. of the line are lightning conductors and switches, by which any section may be cut out in case of accident.

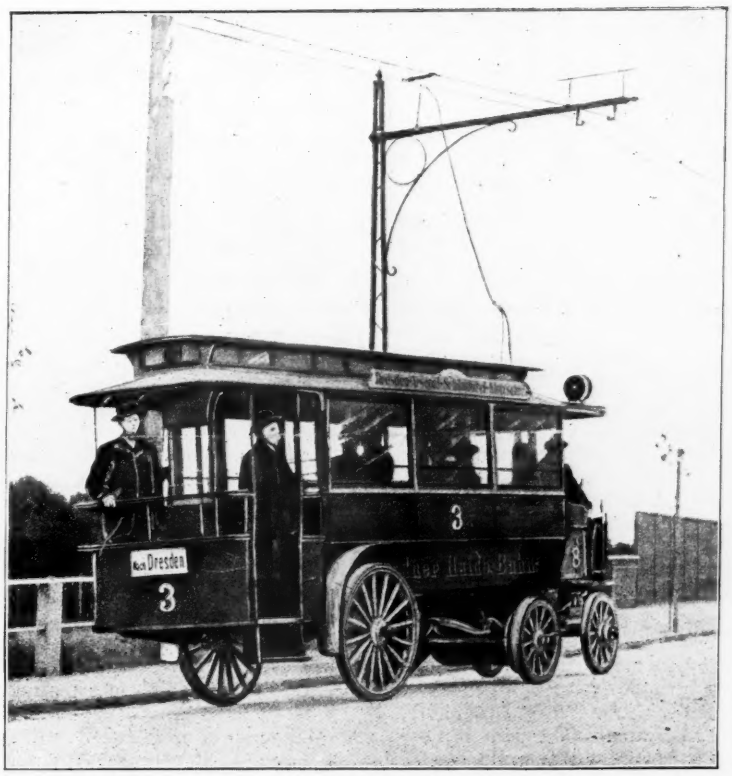


Fig. 1.

In the case of branches from the main line, the ends of the two conductors of the branch line are run alongside the conductors of the main line, no direct connection being necessary.

F

Current is supplied to the line by overhead cables, which may or may not be insulated, and are suspended on masts.

The current is supplied to the vehicle by a trolley which is shown in fig. 2. This trolley consists of a small contact truck with four wheels, and is connected to the omnibus by a flexible cable. One pair of the wheels runs on the positive wire, and the second pair, which is well insulated from the first pair, runs on the negative wire. To prevent derailment of the trolley the centre of gravity is lowered by suspending from it, by a jointed rod, a heavy metal ball. Additional security against derailment is also obtained by guards projecting downward from the bearings of the wheels. Clamped on to the suspending rod is the double stranded cable, one strand being connected to the positive wheels of the trolley and the other strand to the negative wheels. The cable leads to the end of a vertical rod placed on the driver's seat and constructed so that it can be easily lifted out. A tension arrangement built into the cable allows it to lengthen or shorten as required, so that it never hangs and interferes with the traffic passing underneath, even when the omnibus has deviated some metres to either side of the trolley wires. This trolley truck weighs about 3·5 kg., and requires no motor to drive it.

When one omnibus passes another, the drivers pull out the rods connected to their cables and exchange them. Deviations are therefore unnecessary, as no trolley ever passes another.

Fig. 3, in which an omnibus is passing a high furniture van, shows how the new kind of vehicle accommodates itself to the ordinary traffic. The omnibus can deviate over the whole breadth of the street, and thus can pass any other vehicle, so that ordinary traffic is in no way disturbed.

Fig. 4 shows a small motor vehicle with seats for 12 persons and standing room on the platform for 4 persons; the driver's seat is not covered over.

It will be seen that an omnibus consists essentially of two parts, namely, the fore truck, which, apart from the lighting arrangements, contains the whole electrical equipment, and the driver's seat; and the back part which comprises the body of the vehicle proper. The fore truck has two axles, the hinder of which is fixed, and the front one which may be turned by a steering gear on the driver's seat. The car body, which has only one fixed axle at the hinder end, rests at its front end with a pivot connection on the fore truck, and can consequently be easily separated from the latter.

By this arrangement a very favourable distribution of weight on the axles is attained, since the driving wheels have the heaviest load, and the steering wheels are lightly loaded. The steering power of the vehicle, owing to this arrangement, is very great, and it is still further increased by the circumstance that the wheels rotate on the axles.

Experience has shown that with this arrangement it is possible to turn the vehicle in a street of only two wagon breaths, and the adhesion of the driving wheels is sufficient to ascend a gradient of 1 in 10. The wear and tear of the roads is also reduced by the distribution of the weight on the three axles instead of two.

The fore truck is equipped with two series motors, each of 15 H.P. maximum output. This motor capacity has proved itself in practice to be sufficient for the requirements of such a vehicle. The endeavour, of course, is to keep the dead weight down by using the lightest motors which will give the required tractive force. The design of the motor corresponds with the latest Allgemeine Electricitäts Gesellschaft model, which is designed to meet all the electrical and mechanical requirements of practice. Special attention has been given to making all parts accessible and interchangeable, the ventilation of the armature is exceedingly good, the material of the commutator is uniform and good, and the pressure of the carbon brushes on the commutator is uniform. All the bearings are large, and outside the housing, so that lubricant does not enter and destroy the insulation. The motors are suspended on springs, and each of them drives, by means of a pitch-chain, one wheel on the hinder axle. By this arrangement the driving wheels can be driven at different speeds, a circumstance which greatly facilitates the turning of curves. The velocity ratio of the pitch-chain gearing is 1 to 5·43. The speeds and efficiencies of the motors, with various loads, are as follows:—

Load.	Revs. per min.	Speed km. per hour.	Efficiencies.
½	900	23·7	84
¾	700	18·4	85·5
1	600	15·7	84
1¼	525	13·9	81
1½	480	12·6	77

Every vehicle is fitted with a controller switch, a resistance switch, a cut-out, a safety device, and a com-

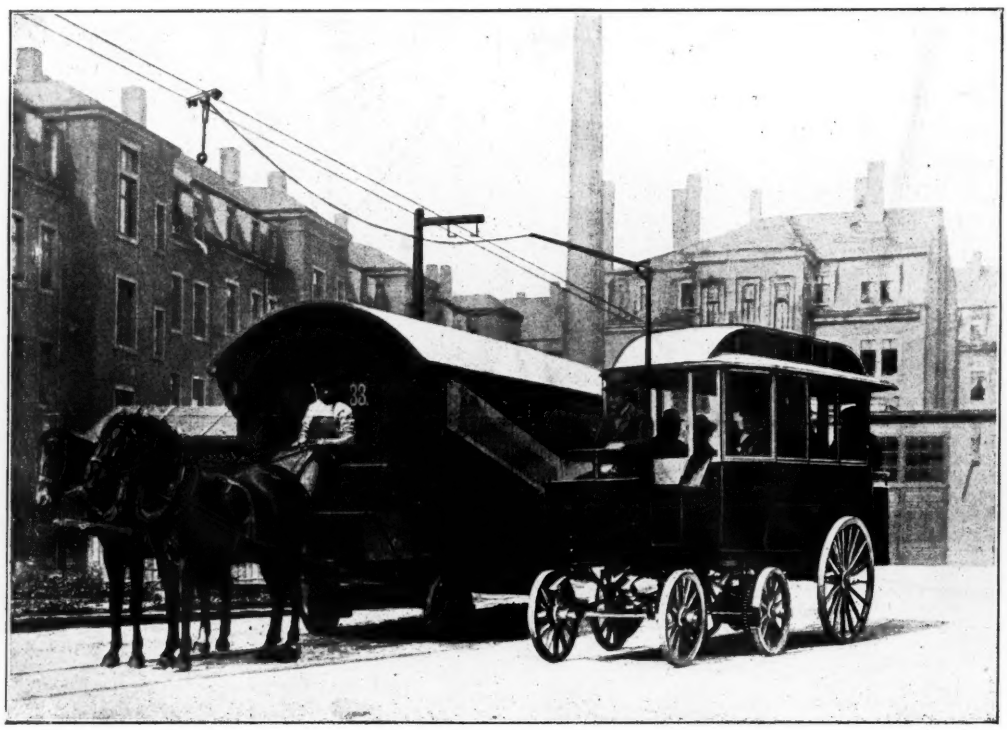


Fig. 3.

plete electric lighting arrangement, consisting of seven glow lamps, two of which are in the signal lamps and five inside the omnibus. The controller switch corresponds with the A.E.G. type F. 11. The speed and tractive force of the vehicle are regulated by placing resistance in series with the motors.

With the electric omnibus there is less risk of disturbance of traffic in winter than with the ordinary tramways. It is an advantage in some cases to replace the hind wheels of the car body by a sleigh.

Fig. 5 shows a goods wagon. The front truck is the same in all cases; it is only necessary to fit on it the required kind of vehicle body.

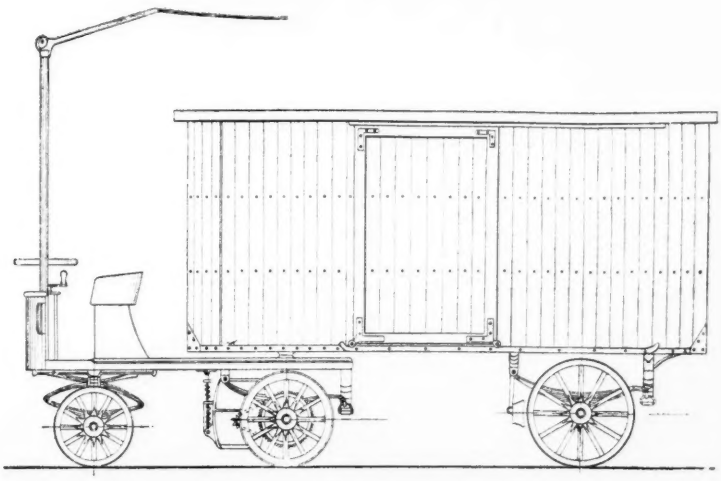


Fig. 5.

Very simple and cheap car-sheds have been designed containing also an office, workshops and, where necessary, a transformer room.

An estimate of the cost and working of this kind of traction will be of interest. The cheapest kind of installation is one in which the building of the vehicles and the supply of the current are the only items to be considered, as when the route is in the neighbourhood of a power station. In such a case the outfit for supplying the current to the vehicles will amount to £250 or £350 per km., and the vehicles will cost from £350 to £400 each.

Where sheds and workshops and a small transformer station have to be erected, the installation costs, for a 3 km. line with a 15-minute service, requiring two vehicles, altogether £2,700, or £900 per kilometre.

The working costs may now be considered. Careful experiments at Dresden have shown that the traction coefficient of a road vehicle is about double that of a vehicle on rails. The consumption of energy varies from 80 to 140 watt-hours per ton kilometre. The first number corresponds to level roads with a hard surface; the second number to gradients of 1 in 25. Comparing the consumption of energy with that of tramway vehicles, it is found that the consumption of an omnibus with 22 places is about equal to that of an ordinary tramcar with 28 places —*i.e.*, the consumption of energy per place is 25 per cent. greater in the case of the road vehicle.

If it is assumed that the cost of the installation is £2,700, working 10 hours a day, every vehicle will run 120 car kilometres per day, or 87,000 car kilometres per annum. The expenditure for working will be as follows:—

Direct Costs.	Pf. per car kilometre.	
Establishment costs	2·5	
Wages	5·4	
Maintenance of rolling stock	2·5	
Maintenance of machines, workshops and fixtures ...	·6	
Cost of current	5·0	
		16
Indirect Costs.		
Renewal and depreciation	2·2	
Interest	1·8	
		4
Total cost		20

According to this, one vehicle must earn per day 120 × 20 pf. = 24 shillings, and since it makes 40 single journeys, ·6 shilling per journey. Charging each person one penny for a journey, it will be necessary to carry an average of 7·2 persons per journey.

There must be many cases in which there is sufficient traffic to pay for the electric driving of the road vehicle, where there is not sufficient to pay for the electric tramway.

COAL-CUTTING MACHINES WITH THREE-PHASE MOTORS.

Among electrically-driven coal-cutting machines, the bar type has recently made very marked progress in the favour of mining engineers. The results obtained in respect of yardage cut, freedom from derangement, and economy of power, place it in the front rank of successful coal-cutting machines. When electric motors were first applied to mining work, it was recognised that the bar coal cutter was the type best suited to electrical driving, the higher speed of rotation relatively to the disc or chain types and the freedom from tendency to jam being the most obvious advantages. The Hurd bar coal cutter, of which Messrs. Mavor and Coulson, Ltd., of Glasgow, took up the manufacture a number of years ago, and which is now known as the "Pickquick," is, however, a very different tool from the crude machine of 12 years ago. The suitability of every detail to its function has been hammered out in hard work

Fig. 4.

at the coal face, and considering the strenuous nature of the work required of them, the record of these machines in respect of freedom from breakdown and small cost of renewals is remarkable. So strongly is the whole machine made, that its capability to cut in very hard material is in no way restricted by the machine itself. The limitations depend upon the possibility of the steel of the cutter picks standing up to the work without too frequent sharpening.

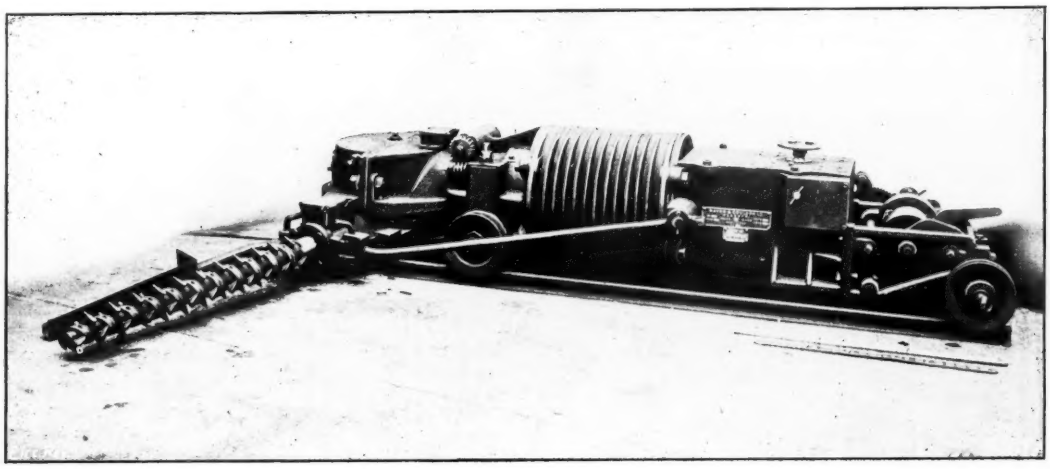


Fig. 1.

Until recently the "Pickquick" machines have been made with direct-current motors only incorporated with them, but the getting to work of electrical power supply companies, which for purposes of transmission adopt polyphase current, has led to a demand for coal cutters with three-phase motors. The first application of motors of this type to coal-cutting machines was made by Mr. Roslyn Holliday at Ackton Hall Colliery, when four "Pickquick" coal cutters were employed. Slip rings were at first adopted for inserting starting resistance in the rotor, but these were discarded by Mr. Holliday in favour of a clutch arrangement which enables the rotor to make a few turns before carrying round the bar-driving gear.

Messrs. Mavor & Coulson have recently added to their standard patterns coal cutters driven by three-phase motors, with squirrel-cage rotors, which do not require any mechanical device to facilitate starting.

The advantages which the bar machine offers to the application of electric driving are emphasised when the motor must be of the polyphase type. The low starting torque and the low overload capacity demanded owing to freedom from jamming render possible the adoption of the induction motor without the use of slip rings, but even under the most favourable conditions it is more difficult to produce a three-phase than a direct current motor which will satisfactorily fulfil all the requirements of a coal-cutting machine. The low headroom available compels a small diameter, and mechanical considerations compel a moderate speed of rotation. It is obvious that these limitations render the design of polyphase motors, especially for frequencies over 30 cycles per second, a problem of considerable difficulty. For the smaller coal cutters working in seams 20 in. thick or less the use of three-phase motors is impracticable. The vertical height of the direct current motor of the small machine does not exceed 12 in.

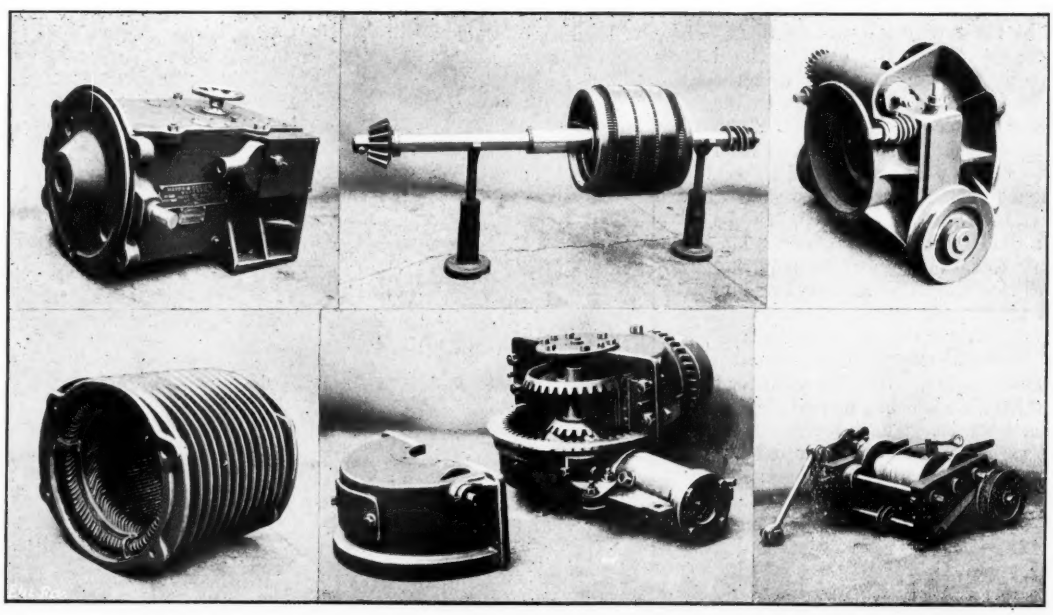


Fig. 2.

The illustration, fig. 1, is from a photograph of the medium size machine, which has a maximum vertical diameter of 22 in. and a motor of 18 H.P. The motor is wound for a frequency of 50 cycles per second and a pressure of

500 volts. This machine undercuts from 3 ft. 6 in. to 5 ft., according to the hardness of the holing. The large machine has a vertical diameter of 27 in., a motor of 26 brake-H.P., and undercuts from 4 ft. 6 in. to 6 ft. deep.

The detail views illustrate the component parts of the machine—gear-head, gear-head socket, stator, rotor and haulage gear.

BUSINESS NOTES.

(*Continued from page* 422.)

Books Received.—"Watch Repairing," by F. J. Garrard. London: Crosby Lockwood & Son. 1903. 4s. 6d. net.

"Electric Wiring Tables," by W. Perren Maycock. London: Whittaker & Co. 1903. 3s. 6d.

"Practical Electro-chemistry," by Bertram Blount. Second impression. Westminster: Archibald Constable & Co. New York: The Macmillan Co. 1903 Price 15s. net.

"Proceedings of the Institute of Marine Engineers." Session 1903-1904. Vol. 15.

"The Elements of Electrical Engineering," by T. Sewell. London: Crosby Lockwood & Son. 1903. 7s. 6d. net.

"The Engineer in South Africa," by Stafford Ransome. Westminster: Archibald Constable & Co., Ltd., 2, Whitehall Gardens. 1903. Price 7s. 6d.

City of London College.—The Michaelmas term commences on September 28th, as announced in our advertisement pages to-day.

Bankruptcy Proceedings.—At Edinburgh Bankruptcy Court on 4th inst., Mr. W. W. Fraser, as sole partner of the firm of W. W. Fraser & Co., electrical engineers, 87A, Fountain Bridge, Edinburgh, was examined in bankruptcy. He said he began business in 1879, and accounted for his deficiency of £1,130 by loss of a motor-car through fire, about £300, less legal expenses £200, loss on stock, over-statement of claims, &c. He had never been in partnership with anyone. His stock had been valued at £75, but was worth a great deal more than that. The statutory oath was administered.

ELECTRIC LIGHT AND POWER NOTES.

Aberdeen.—The accounts of the electricity department show that the total capital expended is £194,079. The revenue during the past year was £30,336, compared with £23,139 in the corresponding period, and the expenditure was £14,791, leaving a surplus of £15,544. After paying capital charges there remains a surplus of £1,701, which has been placed to reserve. The output was 2,987,487 units, as against 1,859,812.

Alvechurch.—The Redditch U.D.C. has received an inquiry as to the terms upon which it would supply Alvechurch with electricity for lighting the village, the demand to start at 9,000 units per annum, with a likelihood of its being doubled in a year or a year and a half. The Lighting Committee recommended the Council to offer to supply Alvechurch at a charge of 6d. per unit at night and 3d. per unit in the day time.

Batley.—The electric light was only switched on at the Corporation's new works about a month ago, but since then good progress has been made. The Corporation has decided to extend the mains to outlying portions of the borough, and an application is to be made to the L.G.B. for sanction to borrow £5,000 to defray the cost. The electric cars have not yet started running. The lines were completed several weeks ago, and the Corporation is now in a position to supply energy; but the cars have not yet arrived. The responsibility for the delay, so representatives of the Corporation allege, rests with the British Electric Traction Co., to whom the lines have been leased. The cars running on the Dewsbury and Spen Valley lines, it is said, are not suitable for the Batley line.

Blaydon.—The U.D.C. recently received a proposal from Mr. C. H. Merz, on behalf of the Priestman Power Co., Ltd., for taking over the Council's responsibilities under its provisional order; the clerk was instructed to ask Mr. Merz for further information.

Brighton.—As an experiment the Lighting Committee has decided that for one year the charge for energy supplied to premises controlled by a time switch shall be 1d. per unit from 8 p.m. instead of from 10 p.m. This is in answer to a request for a reduction of the charge of 7d. per unit to places of worship.

Clydebank.—The plebiscite of the ratepayers in Clydebank, to decide whether or not the T.C. should spend £35,000 on the erection of an electric lighting plant and refuse destructor, has resulted in the scheme being condemned by a large majority—the figures being, "not in favour," 1,104; "in favour," 355. The alternative scheme is that the burgh shall take its electricity supply from the Clyde Valley Electric Light and Power Co., who are constructing works in the district.

Cheltenham.—The municipal electricity works have been running for eight years at a loss, and the local ratepayers' association recently petitioned the T.C. to invite Sir William Preece to investigate the matter personally, or to nominate an expert to conduct an investigation and advise the Council. The matter was referred to the Lighting Committee.

Consett.—As the Cleveland Electrical Power Co. will in a few months be in a position to supply current, the U.D.C. has decided to ascertain upon what terms the company will supply energy for lighting purposes.

Devizes.—The T.C. has decided to apply to the B. of T. for a prov. order under the Electric Lighting Acts. The Council has received notices from the Southern District Electricity Corporation and the Devizes and District Electric Supply Co. of their intention to apply for similar orders, and the Council has resolved to obtain the advice of an electrical engineer or other expert.

Dublin.—The Corporation wants £43,000 to complete the electric lighting scheme, in addition to the original estimate of £254,500.

Eccles.—The T.C. has ratified a resolution of the Public Lighting and Electricity Supply Committee, reducing the charge for energy supplied for motive power. It was reported, at the last meeting, that the loss on the electric light undertaking during the past three months had only been £229, against £372 during the same period in 1902. The Monton route, now completed, will be worked by the Salford Coporation. It is to be opened immediately.

Elgin.—The T.C. has received a proposal for the supply of electricity generated by water-power. The matter is under consideration.

Gloucester.—A L.G.B. inquiry was held last week into an application by the T.C. for sanction to borrow £25,000 for the electricity undertaking, including the provision of additional plant required for supplying power for the proposed light railways. The items were as follows:—Extension of building, £1,887; generating plant, £7,080 16s. 9d.; proposed sub-station at the Cross, £400; suggested extension of mains, £3,674 11s. 7d.; provision for 200 new house services, with meters, £2,000; proposed extension of public lighting, £3,500; which, with excess amount of capital expenditure on loans previously borrowed, £6,457 11s. 8d., made a total of £25,000. Mr. W. J. Bache, electrical engineer, gave technical details of the proposed extension, and there was no opposition.

Grimsby.—According to the report of Mr. W. A. Vignoles, the borough electrical engineer, the gross profit made by the electricity department last year was £3,277; after paying capital charges there was a deficit of £1,422. The output was 653,438 units, of which more than half was for traction; the connections amount to the equivalent of 21,334 8-C.P. lamps. Sanction has been received for an outlay of £7,000 on extensions of mains.

Huddersfield.—The T.C. has resolved to apply to the L.G.B. for sanction to borrow £7,500 for supplying the township of Linthwaite with electrical energy.

Extensions of considerable magnitude are contemplated to the Corporation electric lighting works, the estimated cost being £100,000.

Liverpool.—A motion by Councillor T. Utley, proposing "That the Electric Power and Lighting Committee should obtain expert evidence as to the cost of lighting electrically the whole of the tramway routes and main thoroughfares in the city" was discussed at the meeting of the Liverpool City Council last week. Mr. Utley contended that the work of lighting could be done at much less cost than that shown by the estimates which had been obtained.

London.—ISLINGTON.—According to the local press, trouble is brewing over the electricity undertaking. A recent financial statement by the borough accountant shows that the total outlay has been £388,670, of which only £20,646 has been paid off out of revenue. The undertaking has shown during eight years a fluctuating margin of profit and loss, inclining to the latter on the whole—though, without a blush, the *Islington Daily Gazette* declares that there has been a profit of nearly £20,000. There appears to be no reserve whatever, and last year the *increase* in repairs amounted to no less than £2,281. There was also a deficit of £1,740. Be it observed that these ominous features appear in the eighth year of a municipally-owned supply undertaking in the metropolis, where, moreover, a period of 42 years is allowed for repayment of loans. No reserve; a deficit; heavy and increasing cost of repairs—what prospects lie before this unfortunate concern? We fear they are not very brilliant.

BATTERSEA.—Mr. Frank Whitehead, foreman at the Borough Council's electricity works, recently had occasion to discharge a number of employés for general slackness. There were several stormy scenes, and the services of the police had to be requisitioned to prevent rioting. On Friday, at the South-Western Police Court, one of the dismissed men was fined £5, or one month's imprisonment, for assaulting Mr. Whitehead.

Poplar.—The Electricity Committee of the B.C. has resolved that Nernst lamps be fitted experimentally on the columns in one road. The Committee has already informed the Council that the demands of present consumers may be dangerously near the limit of the supply at the peak of the load in the winter months, but in view of the liabilities of the Council under the prov. order and its decision against authorising refusal of connections, the Committee is of opinion that the Council should take the responsibility of accepting a number of new applications. At a meeting of the Finance Committee, a letter was read from the L.C.C., stating that that body was prepared to advance a loan of £3,345 for electricity works. A motion that the mortgage be sealed was carried.

Shoreditch.—Adopting a report of the borough electrical engineer, Mr. C. N. Russell, pointing out the increasing demand and the economy of supply at higher pressure, the B.C. has decided to change over the distribution system to the three-wire system at 240 and 480 volts. The supply is at present given at 150 volts on the two-wire system. The cost of the change is estimated at £6,000.

Mansfield Woodhouse.—The U.D.C. is to apply to the B. of T. for a prov. order for electric lighting, with a view to obtaining electricity from the Mansfield T.C.

Nelson.—The Corporation is about to apply to the L.G.B. for leave to borrow £25,000 for the purposes of the electricity department. The Council has overspent its borrowing powers to the extent of £14,000.

Newport (Mon.).—The Electricity and Tramways Committee will recommend the Council to proceed with the public arc lighting as previously decided upon, in preference to accepting the gas company's offer to erect 144 lamps with triple Welsbach burners at a cost of £2,448.

Queenstown.—At the half-yearly meeting of the Queenstown Gas Co. last week, the chairman said, in submitting to the shareholders the statement of accounts for the past half-year, the directors regretted to say that the result had not been satisfactory as compared with that of the corresponding period of 1902. He found the report unsatisfactory, inasmuch as they had not anything, little or much, to distribute amongst the shareholders. The Queenstown Gas Co. had an excessively keen competition to meet on the part of the local electric lighting company, and he had before him their position. The gas company was an old company, about 54 years established, and for many years past when they were earning money in a very satisfactory manner, they did not make any endeavour to put by anything for the rainy day. They were met with the fact—the glorious fact—that the electric lighting company were going to wipe the gas company off the face of the earth. The electric company came to Queenstown and started in the town with everything possible in their favour. They expended an initial outlay of £20,000, equal to that of the gas company; they ran the latter company hard for some years. But last year the electric company had earned just £5 more than the gas company had earned. The electric company's outlay in Queenstown last year was £1,778 19s. 8d., and they earned £1,791 12s. 8d., leaving them an amount to distribute of about £12, as against the gas company's £3.

South Shields.—At the meeting of the T.C. on the 2nd inst. Alderman Rennoldson said the reports that had been given by the Press did not give full justice to the undertaking. The profits for the year ending March last were altogether £1,695. As a matter of fact, they had, at the end of the financial year, an accumulated balance of £2,110, and that and the profit made the total sum at their disposal £3,806. They then carried £2,700 to the reserve fund, which left £1,100. That latter sum was left an open account, to see if, after the summer half-year, they could recommend that a portion should be handed over to the rates. This they had been able to do at their last meeting, when they recommended that £800 be handed over to the general district rate.

Stockton-on-Tees.—The assessment of the Corporation electricity works has been reduced from £1,279 to £564, equivalent to a saving of £252 per annum.

ELECTRIC TRACTION NOTES.

Brighton.—The T.C. has decided, by a majority of 18 to 10, to lay the electric tram route along Dyke Road with Corporation labour, under the supervision of Mr. J. B. Holliday, tramways manager.

Central London Railway.—On Tuesday evening, at about 7 p.m., a stoppage occured on this railway, at the Bank end of the line, through a coach leaving the rails between Bank and Post Office Stations. A following loaded train was brought to a standstill, and the electric lights were extinguished. The passengers passed out through the rear carriage, and, lights having been switched on in the tunnels, they were able to pass along the wooden pathway to Bank Station. There was no panic or mishap, though, of course, there was some anxiety.

Crewe.—A tramway scheme for Crewe is at present under discussion, the point of contention being as to whether it should be a municipal or a private undertaking. The ratepayers declared some time ago, by a large majority, against the Town Council undertaking it. The London and North-Western Railway Co.—the largest ratepayers in the town—would oppose a municipal line, unless the tramway terminus were within easy access of the Crewe station and works. The Trades Council of the borough has protested against a private company being allowed to take possession of the streets of the town. The total cost of the scheme is estimated at £100,000 or £150,000.

Glasgow.—Notice of motion has been made in the T.C. that an instruction be given to the general manager of the tramways to at once provide larger cars than those at present in use. The whole question of ½d. fares has been remitted to a sub-committee of the Tramways Committee of the T.C.

Huddersfield.—By means of swing brackets attached to each end of the car, arrangements have been made by the Huddersfield Corporation tramways manager to carry four cyles on each car at the owners' own risk. Mr. Thomas contemplates that this will be the means of increasing the revenue to an extent which will make it worth while to fit up the cars with the swing brackets.

Liverpool.—The Corporation has received the sanction of the B.O.T. to an alteration of the speed of the electric cars. The highest speed which has been nominally attainable under sanctions recently operating is 10 miles an hour. This rate was operative on 34 miles 216 yards of single track, equal to 36 per cent. of the whole. On 52 miles 1,314 yards, eight miles an hour has been attained, equal to 55 per cent. of the whole. On 8 miles 1,560 yards, six miles an hour has been attained, equal to 9 per cent of the whole. Under the new sanction a speed of 14 miles an hour will be allowed on 9 miles 400 yards, and a speed of 12 miles an hour on 51 miles 1,081 yards. The track on which these higher speeds are permitted is in places where it is likely that a long clean run with few interruptions will be obtainable. On 25 miles 150 yards, a speed of 10 miles an hour will be attained. The average speed in the past between the termini has been 5·8 miles per hour. Under the new arrangement an average speed of eight miles, including stoppages, will be maintained. Recently, a series of records were taken of the running of cars, by means of Elliott's recording speed indicator, and it was found that on a typical route a speed of 16 and 17 miles an hour was obtained, the average speed, including stoppages, approximating eight miles an hour. The facts were submitted to the Board of Trade, and a fresh inspection of the whole of the tramway routes was made by Lieut.-Col. P. G. Von Donop, R.E., which has resulted in the sanction of the Board of Trade being given to the increased speed on the tramways. The large immunity which Liverpool has enjoyed from fatal accidents has, no doubt, been a guiding factor with the Board of Trade in the matter.

Last week the City Council adopted a recommendation from the Tramways Committee that 10 of the ordinary electric cars be fitted with the new top-cover lately produced by officials of the works department, at a cost of £35 per car, and that 10 of the existing top-covered cars be fitted with the improved parts of the new cover, at a cost of £15 a car.

Last Saturday a serious electric car collision occurred. A cart turning from a side street was smashed, and three occupants severely injured.

London.—Further work was commenced by the L.C.C. contractors on Monday for the electrification of the tramways. In Southwark Bridge Road a number of men commenced to tear up the eastern side of the roadway, a temporary line having been previously laid down on the western side. The new portion of the line which is being laid down in the Marshalsea Road, to connect the lines between the Borough High Street and Southwark Bridge Road, is being proceeded with rapidly, while in that portion of Southwark Bridge Road which runs right up to the bridge itself the metals have been laid down and the necessary junction lines made for the trams to resume the return journeys. The new line along St. George's Road, between the Elephant and Castle and the Westminster Bridge Road, is also being rapidly laid down.

L. & N.W. Railway.—The announcement has been made in a number of newspapers that the directors of this railway have decided not to electrify any portion of their main lines between Euston and Scotland or Euston and Holyhead. "Such a change would involve enormous outlay, while steam would still be needed for the heavy mineral trains. It is probable that in the near future several branch lines may be electrified, but steam would still be retained for heavy traffic."

Manchester.—Some interesting particulars were given by the chairman of the City Tramways Committee, Mr. Boyle, at the meeting of the Council last week relative to prospective developments in the district. The Manchester Southern Tramways Act, which was passed last session, had, he said, become practically the Act of the Corporation. It authorised the construction of tramways from Barton Bridge (the boundary of Eccles), along Croft's Bank Road, by Davyhulme and Urmston, to Stretford, and thence by Sale and Northenden to Gatley, where it will connect with the tramway system of the Stockport Corporation. Thus a complete ring of tramways will be formed round the city on its southern side. There is also to be an extension along the Manchester and Altrincham main road from Stretford to West Temperley; and under an arrangement to be concluded with the Altrincham District Council, through communication between the city and Altrincham will be established at no distant date. What

the Manchester Tramways Committee has aimed at from the first is being accomplished, namely, through tramway connections along all the main roads leading out of the city with the surrounding towns. By way of Northenden, the towns of Stockport, Denton and Ashton will be reached by alternative routes. Manchester is already connected with Middleton, and the Committee has made overtures to the Oldham Corporation for the running of through cars to that town. Having established a car service, Mr. Boyle said, to the principal large towns, the Committee's purpose was now pretty well served.

The "cow-catcher" is to be superseded on the electric tramcars, and we learn that the Corporation is so satisfied with the Hudson-Bowring "gate and carrier" guards that it has given an order for 300 of them to Messrs. Hudson and Bowring, Ltd., of St. James's Square, Manchester. The principle of the guard is as follows:—The swing-gate which hangs below the "fender" of the car is so lightly balanced that at the least touch it falls inwards. In doing so it automatically opens a "toggle" or knuckle lever, releases an iron bar, and causes the horizontal carrier or cradle to fall to the ground. The cradle is pressed down upon the metals by a strong spring, and any obstruction is easily picked up and carried along until the car can be brought to a standstill. It is claimed that these guards render it practically impossible for any one to be injured by the wheels or mechanism of the car.

Metropolitan District Railway.—Although it has been publicly stated that the electric trains on the District Railway cannot be running for passenger traffic until the end of 1904, there is strong ground for believing (says the *Daily Chronicle*) that a partly electric service will be put in operation on the Inner Circle in some seven months' time. "Experiments on the line at South Harrow are still going on, with a view to deciding on the type of motor to be adopted."

Newcastle-on-Tyne.—At the meeting of the T.C. on the 2nd inst., Councillor Cairns raised the question by what authority, and under what circumstances, communications had been entered into between the Tramways Committee and the Tyneside Tramways and Tramroads Co. Mr. Cail, chairman of the Committee, said negotiations were entrusted to a sub-committee by the Tramways Committee. Mr. Cairns moved that the Council request the Tramways Committee to carry on no further negotiations with the company in regard to running powers over the two systems without distinct instructions from the Council. Mr. Cail pointed out that the friendly overtures that had taken place, were really more in the nature of an exchange of traffic than allowing another company running powers. Broadly, what they were endeavouring to bring about was an arrangement to allow the Tyneside tramcars to come into Newcastle as far as Stanhope Street, and to allow the same number of the city cars to go as far as North Shields. Eventually Mr. Cairns withdrew his motion in order that the Tramways Committee might consider the matter.

At a meeting of the Finance Committee on the 3rd inst., the Mayor, Sir William H. Stephenson, presiding, the city treasurer reported that the amount paid up to date for the construction, equipment, &c., of the city tramways was £962,000; of this amount above £800,000 had been borrowed, and it was proposed to borrow a further sum of £128,000, when the sanction of the Local Government Board had been obtained. This sum is for tramways and the necessary street improvements.

Northampton.—The Finance Committee has recommended the T.C. to apply for a loan of £75,000 for the electrification of the tramways.

N.E. Railway.—The North-Eastern Railway last week commenced its service of motor omnibuses in North Holderness, between Beverley and Belford. The 'buses, which are propelled by 24-H.P. four-cylinder Stirling motors, giving an average speed of 12 miles an hour, resemble the ordinary electric tramcar, and provide accommodation for 16 passengers. It is proposed at present to make four journeys daily in each direction.

St. Helens.—The state of the tramways and of the rolling stock formed the subject of discussion at the last meeting of the T.C. It was said that the cars were run in a bad state, and damaged the rails and points, and that then the company using the lines complained. Councillor Houghton said it was going to be a dead loss to the Corporation if they had to relay the lines so soon. The chairman thought it was quite right that they should call the attention of the company to such matters.

South Shields.—The question of the working of the electric tramways, for the construction of which the Corporation has recently obtained an Act, is still under consideration. A proposal has been made by a member of the Corporation that that body should itself work them, and this suggestion which has just been made public seemingly provoked the present lessees (the South Shields Tramway and Carriage Co., Ltd.) to make the appended proposal on the 31st ult. to the Corporation:—(1) The Corporation to construct and electrically equip the tramways, the company (the South Shields Tramway and Carriage Co.) providing the necessary rolling stock; (2) the Corporation to grant this company a lease of 28 years from the date of the certificate of the Board of Trade for electrical working; (3) the company to pay interest and sinking fund upon the total capital cost of constructing and equipping the said lines; (4) the company will relieve the borough of the debt, which they understand now stands at about £9,000 against the tramway account by including that amount in the capital upon which interest and sinking fund will be paid; (5) the Corporation to supply all energy required for the tramways at the following rates:—For all units up to 200,000 per annum 1·5d. per unit; for the next 50,000 1·4d. per unit, and reducing by one-tenth of a penny per unit for each additional 50,000 units until 400,000 units per annum is reached, when all units in excess will be charged at the rate of 1d. per unit; (6) the Corporation to have the option of acquiring so much of the Jarrow and South Shields Light Railway as is situated in that borough; (7) the company would submit on an amicable understanding being arrived at to surrender the present lease which it holds from the Corporation in respect of the existing tramways. In the event of terms being arranged application will be made for powers to construct a line from Westoe to Whitburn.

At a meeting of the T.C. on the 2nd inst., Councillor Gibbon moved that the Corporation should provide and run the trams, to be electrically equipped on the overhead system, and that they should at once proceed with the construction of the lines, &c., in Fowler Street, Westoe Lane, Meldon Terrace and Stanhope Road to Tyne Dock. He pointed out that the Corporation was now in a position to proceed with the work of extending the system, and the populous character of the district through which they would pass would ensure their success. Councillor J. W. Henderson seconded. He contended that they could not have a complete and efficient system unless it was not only owned and laid, but also worked, by the municipality. The tramway company were taking at present £350 per week, or 84,000d. per week, and he ventured to say that on the new system they would carry the population twice per week, which would mean an income of £45,933 per annum; the operating cost he put down at 65 per cent., which would absorb £29,564. The total amount charged to the undertaking would be brought up to £41,151, which, when deducted from the revenue, left a balance of £4,782, which would be increased to £5,882 at the end of five years. Alderman Lawson moved an amendment that the question of leasing or working the tramways should be deferred until the Tramways Committee had ascertained the best terms which could be obtained for a lease of the lines, and also that the routes to be equipped at the present time should be left over for the Committee to consider. Councillor Smith seconded this, but the matter was eventually adjourned.

A special meeting of the T.C. was held on the 7th inst. to further consider the matter. There was a long discussion, but practically the only points were, on the one side, that the only solution to the question was municipalisation, that the T.C. knew that the only offer they would get to lease the tramways would be from the B.E.T., that they already knew the terms that would be offered, and consequently no gain would be obtained by further delay; on the other side it was contended that they were under a practical obligation not to municipalise until the case for leasing had been gone into fully, and that while there was a very considerable risk in working the tramways themselves, and doubt as to whether they would pay, there was no such risk involved in leasing them, whereby a certain income would be obtained without the risk. The ultimate vote was in favour, by 18 to 14, of an amendment that the question go back to the committee, but this can hardly be considered a decisive vote against municipalisation, as at least two of those who voted for the amendment declared themselves municipalisers, and voted against the motion on questions of detail; had these two votes been transferred the voting would have been equal.

Wolverhampton.—A meeting of the Town Council is to be held on Monday next, when it is expected that some official announcement will be made as to the negotiations between the Council and the Lorain Co. As has been previously stated in these columns, Mr. Wetmore, the agent of the company in Wolverhampton, paid a visit to America in order to consult with his principals; and it is rumoured that the company has declined to accept the proposals which have been made by the Corporation.

TELEGRAPH AND TELEPHONE NOTES.

Australian Telephones.—In the House of Representatives at Sidney, in July, it was stated that a metallic circuit for the telephonic systems of Melbourne and Sydney could not be provided for out of revenue, and until a loan was provided the work could not be gone on with. The matter was to be considered when the estimates were under discussion.

Glasgow Telephones.—The annual report of the Corporation Telephone Department, which has just been issued, shows the net revenue to be £14,143, made up as follows:—Proportion of rentals brought from last year, £12,417; gross revenue from rentals for the year, June 1st, 1902, to May 31st, 1903, £42,176, less proportion of rentals applicable to year 1903-4 carried to suspense account, £20,715, a total of £21,461, to which have to be added sundry receipts, including terminal fees, £366, a total revenue of £35,014; the working expenditure (including Post Office royalty, £3,405, and terminal fees, £1,498), was £20,871, giving the net revenue of £14,143, out of which the following requirements had to be met:—Interest on loans, £6,642, and sinking fund, £5,807, leaving a surplus on the year's operations of £1,690, which, with the surplus brought from last year of £398, gives a total surplus of £2,092. This sum is carried to a general reserve fund. The net amount of borrowing powers at May 31st was £292,233, of which £49,700 is unexhausted. The capital expenditure for the

year amounted to £78,245, which, with the capital expenditure of £192,694 previously incurred, make a total capital expenditure of £270,939. The amount of capital invested in works not yet earning revenue is £59,096. At May 31st there were 9,122 instruments connected, these being subscribed for by 8,145 persons and firms, of which about 4,600 have never been telephone subscribers before. About 800 orders remain to be executed. The number of instruments now working with the exchange is 9,856.

Halifax Telephones.—The Finance Committee on 4th inst. decided to recommend to the favourable consideration of the Town Council an offer received from the Mutual Telephone Co. to establish their telephone system in the borough. The acceptance of the offer is recommended in preference to the introduction by the Corporation of municipal telephones, which, through their last Parliamentary Bill, they received power to adopt.

New Zealand Telegraphs.—According to the report of the Post and Telegraph Department of New Zealand, there are now 22,672 miles of telegraph wires in operation in the colony, an increase of 967 miles on the year.

The Picard System for Submarine Telegraphy.—A short time ago some successful trials were carried out in effecting direct communication between Paris and Algiers by means of the Baudot apparatus. The total length of the line was 1,800 kilometres, of which 900 kilometres were cable. The trials took place on the occasion of the visit of the President of the French Republic to Algiers. A correspondent sends us some details of the system adopted to overcome the difficulties of fast working on the cable; the arrangement was designed by M. Picard, an employé of the Department of Posts and Telegraphs in France. In order to overcome the difficulty of retardation due to the capacity of the cable, it has always been necessary to employ currents as short and weak as possible. This has been supplemented by Lord Kelvin's method of reversing currents. M. Picard has devised a further and most ingenious method of employing the periods of *rest* between the emitted currents to produce the signals. The "tail" of the current, hitherto considered the enemy of the submarine telegraphist, has now been made his best friend. Instead of the length *of* the current forming the dots and dashes, the signals are made by the length of time *between* the currents. The currents are all of equal length and strength. In the picturesque language of a French engineer: "On parle, pour ainsi dire, avec des silences." Each signal is composed of two currents of equal duration, one positive and one negative. Between these two currents, the positive and the negative, a period more or less long, distinguishes the dash from the dot. The system can also be applied to printing telegraphs with equal success, as witness the recent trials. The transmissions from Paris to Algiers direct were effected by means of translating relays inserted at Marseilles. Paris can employ a four-armed set to Algiers; the arms unemployed at Paris are used at Marseilles. The Central Office at Paris can on occasion give up two arms to the Elysée Office, and the Central Office at Algiers can on its side give up two arms to the palace of the Governor-General, thus establishing direct communication between the offices of the President of the Republic and the Governor-General.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Trinidad-Demerara No. 2	Aug. 26, 1903	
Dominica-Martinique	May 8, 1902	
St. Lucia-Martinique	May 8, 1902	
Guadeloupe-Martinique	May 9, 1902	
Martinique-Puerto Plata	July 10, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-St. Vincent	Sept. 19, 1902	
Reissa-Issa	Oct. 22, 1902	
Reissa-Yemani	Oct. 22, 1902	
Paramaribo-Cayenne	Feb. 27, 1903	
New York-Haiti	April 13, 1903	
Fao-Bushire	July 28, 1903	Sept. 5
Bolama-Bissao	Aug. 4, 1903	
Antigua-Guadeloupe	Aug. 9, 1903	
Corea-Seoul-Genzan	July 30, 1903	
Landlines.		
To Puerto Barrios	July 28, 1903	
Rome-Pera	Aug. 7, 1903	

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—October 3rd. The Municipal Authorities of Liège are inviting tenders until October 3rd for the supply of six electric tramcars. Particulars may be obtained from, and tenders are to be sent to, Le Bureau Administratif des Travaux, à l'Annexe de l'Hotel de Ville, Liège.

Bermondsey.—September 21st. Dust destructor plant, 300-kw. steam generators, feeder boosters, motor balancer, switchgear, cables, &c. See "Official Notices" September 4th.

Brighton.—October 5th. Steel rails, tramcars, points and crossings for the Corporation tramways extensions. See "Official Notices" to-day.

Brisbane.—September 30th. The Deputy Postmaster-General is in the market for certain postal and telegraphic material.

Croydon.—September 14th. Buildings, smiths' and ironfounders' work for the electricity works extensions. See "Official Notices" September 4th.

Cuba.—September 28th. Tenders are being invited until September 28th by the municipal authorities of Cienfugos for the concession for the electric lighting of the public streets and buildings of the town.

Holland.—October 1st. Tenders are being invited by the municipal authorities of Utrecht for the construction and equipment of a central electricity station for lighting and power purposes, and for the working of a tramway.

Isle of Thanet.—The Isle of Thanet Electric Tramways and Lighting Company wants tenders for stores. See "Official Notices" to-day.

Johannesburg.—September 21st. 70 10-amp., 40 25-amp., 10 50-amp. electricity meters. See "Official Notices" to-day.

Johannesburg.—October 5th. A large quantity of steel rails, fishplates, tie-bars, &c., for the Corporation tramways. See "Official Notices" to-day.

Johannesburg.—November 16th. Gas producer plant; gas engines and dynamos. Alternative:—Water-tube boilers, steam engines or turbines, electric generators, and other plant. For the municipal tramways and electrical supply scheme. See "Official Notices" August 28th.

[The attention of tenderers is requested to the change of date for receipt of tenders, from October 19th to November 16th.—Eds.]

Kirkcaldy.—September 14th. Electrical wiring and fittings for the Corporation Memorial Halls. Form of tender, &c., from the Burgh Electrical Engineer.

Launceston (Tasmania).—September 28th. 500 or more electric meters. See "Official Notices" June 12th.

London.—October 6th. Four 5,000-h.p. vertical-horizontal steam engines, each suitable for driving a three-phase generator, for the Greenwich power station. See "Official Notices" July 24th.

Merthyr Tydfil.—September 12th. Hills Plymouth Co., Ltd., invites tenders for stores for the 12 months ending September 30th, 1904. The following are some of the items:—India-rubber, asbestos, &c.; steam tubes and fittings; electric appliances.

Portugal.—October 21st. Tenders are being invited until October 21st by the Portuguese Ministry of the Colonies in Lisbon for the concession for the electric lighting of the town of Macao in the Portuguese Colonies.

Reigate.—September 17th. Water-tube boiler, piping, 200-kw. steam alternator, switchboard and instruments, condensing plant, cooling tower, &c., for electric lighting. See "Official Notices" September 4th.

Rochdale.—September 26th. Electrical work at the Dearnley Workhouse. See "Official Notices" September 4th.

Roumania.—October 10th. Tenders are being invited until October 10th by the Roumanian State Railway Authorities in Bucharest, for the installation of a complete electric lighting plant at the railway works in that city.

Salford.—September 19th. High-tension cable. See "Official Notices" September 4th.

Southend.—September 14th. Steam dynamo, boiler and condenser for the electricity works. See "Official Notices" August 28th.

Spain.—September 18th. The Spanish Post and Telegraph Authorities are inviting tenders until September 18th for the concession for the establishment and working of a central telephone exchange at Palamos (Gerona province) with sub-stations at San Feliu de Guisols and Palafrugell. Tenders are to be sent to La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid, whence particulars may be obtained.

Stoke-upon-Trent.—September 11th. Pipe-work, non-conducting covering, and water-softening plant for the electricity scheme. See "Official Notices" August 21st.

Sweden.—October 15th. Tenders are being invited by the municipal authorities of Gelfe until October 15th for the supply of six electrical cranes.

Whitechapel.—September 12th. Electric lighting of a portion of the Infirmary. See "Official Notices" August 28th.

CLOSED.

Bolton.—At the meeting of the T.C. last week, the Tramways Committee's minutes came up for approval. Mr. Preston moved an amendment vetoing the acceptance of a tender by Jacob and Co., a Belgian firm, for rails required for tramway construction, and accepting that of Messrs. Scott, an English firm. Mr. Walmsley supported the amendment, on the ground of the superior quality of British steel. Alderman Smith, Chairman of the Tramways Committee, said it would be wiser to place the order with the English firm, and upon a division this was ordered to be done.

Chiswick.—The following tenders were received for gas-driven sewage pumping plant, compressors and electric lighting sets for the U.D.C.:—

Bilbie, Hobson & Co.	£6,500 0 0
Campbell Gas Engine Co., Ltd.	3,513 7 6
Crossley Bros., Ltd.	3,304 0 0
Drysdale & Co.	1,980 0 0
J. & H. Gwynne, Ltd.	5,305 0 0
Gwynne & Co.	3,527 0 0
Pollock, Whyte & Waddel	3,202 0 0
Sir Hiram Maxim Electrical Engineering Co. (Accepted)	3,197 2 0
D. Stewart & Co. (1902), Ltd.	2,772 0 0
Tangyes, Ltd.	4,470 0 0
John Wolstenholme & Son.	3,562 10 0

Acting on the recommendation of the consulting engineers, Messrs. Swinburne, Cooper & Baillie, the Council has accepted the tender of the Sir Hiram Maxim Electrical Engineering Co.

Falkirk.—The Parish Council has accepted the offer of Messrs. Thomson & Co., of Falkirk, to fit up the new poor house for electric lighting, with 450 lights at £390 (including special fittings). Some of the other tenders were as follows:—Laurie & Co., Falkirk, £450, with £34 5s. for special fittings; Wallace & Connel, Falkirk, £559 13s., with £36 10s. for special fittings; C. Hamilton, Ltd., Glasgow, £546, with £35 for special fittings; Still & Co., Glasgow, £605, with £40 12s. for special fittings; Milne & Sons, Edinburgh, £630 7s., with £34 5s. for special fittings; James Gray & Sons, Edinburgh, £759 2s. 6d., including fittings; Anderson & Muir, Edinburgh, £741 10s., with £48 10s. for special fittings.

Liverpool.—The City Council has accepted the tender of the Wheeler Condenser and Engineering Co. for condensing plant required at the first section of the new generating station at Lister Drive, at £11,975.

Metropolitan Asylums Board.—At the weekly meeting of the Metropolitan Asylums Board, held on Saturday, the following tenders were submitted for the wiring of the Children's Home at the Tooting Bec Asylum for electric lighting purposes:—

Messrs. Buchanan & Curwen, 64, Victoria Street	£398
" Wenham & Waters, Ltd., Croydon	407
Mr. V. G. Middleton, Westminster, S.W.	443
Messrs. Eastlakes, Ltd., Cowley Street, S.W.	450
" Drake & Gorham, 66, Victoria Street	496
" Hayward, Tyler & Co., Whitecross Street, E.C.	503

The tender of Messrs. Buchanan & Curwen was accepted.

Poplar.—The E.L. Committee has accepted the tender of the International Electrical Engineering Co. for carbons for arc lamps at the following prices:—Brand C.T.E., 18 mm., £2 14s. per 1,000 ft., 12 mm., £1 3s., 16 mm., £2 3s. 6d., 11 mm., £1 1s. 13 tenders. The same Committee has accepted the tender of Messrs. H. Edie & Co. at £67 15s. 6d. for pipework to connect the hot wells with the chemical re-action filter. There were four tenders. The Committee has placed an order with the British Insulated Wire Co. for seven cable drums.

Twickenham.—An order has been placed with Messrs. Pritchetts & Gold, Ltd., of Feltham, for a storage battery for the Twickenham & Teddington Electric Supply Co.'s sub-station at Teddington; there will be 260 cells of 750 ampere-hours capacity.

FORTHCOMING EVENTS.

Monday, September 14th.—At 8 p.m. Institute of Marine Engineers. Paper by Mr. Stephen H. Terry on "Auxiliary Pumping Machinery and Suggested Improvements."

Saturday, September 19th.—At 3 p.m. Civil and Mechanical Engineers' Society. Visit to the generating station of the L.C.C. South London Tramways at Tooting.

ADDENDA TO ELECTRICITY WORKS LISTS.

Dublin.—Lamps connected, 35,000. Units sold, 766,924; ave. price obtd., 5·27d.; works costs, 2·66d.; total costs, 3·27d. The new three-phase plant will be opened on 15th inst.

London (Shoreditch).—New works (Whiston Street) opened 1902:—4 B. & W. marine boilers; 2 Wallsend slipway vertical engines coupled to Westinghouse generators; total capacity, 1,600 kw. Max. load recorded (both stations), 1,880 kw. Total capital outlay, £289,744. Pb. ltg., 286 arc. Motors, 300 = 1,500 b.h.p. Price chgd., ltg. 5d. and 2d. (basements 4d.), pr. 2d. Units sold, 3,040,964; ave. price obtd., 3·034d.; works costs, 2·07d.; total costs, 3·041d.

NOTES.

Electricity v. Gas.—The inventiveness of our friends the gas companies is only equalled by their unabashed persistence in defamation of the electric light and glorification of the incandescent gas lamp—once so heartily detested by them, but now regarded as their only chance of salvation from extinction. The latest effusion emanates from Tottenham, and purports to show, with an engaging and delusive fairness, that electricity costs nearly six times as much as gas for lighting purposes. This result is arrived at as follows:—Gas costs 3s. per 1,000 cb. ft., and with "even ordinary incandescent burners and cheap mantles" gives 15 candles per cb. ft. per hour, or 1,665 candles for one hour for 4d. Electricity costs 4d. per unit, giving, at 3½ watts per candle (observe the fairness!), 285 candles for one hour for 4d.; and 1,665÷285 = nearly 6. Q.E.D. Renewals are taken as equal in both cases — the "50-candle" (!) gas light being maintained by the company for 3s. per annum, while in the same period three 16-c.p. or six 8-c.p. electric lamps "will cost more than that sum for renewals."

It is, no doubt, somewhat superfluous to point out the fallacies and the cunning omissions with which these statements are compiled; the proof of the light is in the burning, and we are quite content to abide the verdict of the unbiassed user. But for the sake of those amongst us who ask *why*, in the face of these allegations, electric lighting thrives apace, let us look into them for a moment.

Take the case of a dwelling house with eight rooms, fitted up as follows:—

Dining room, 3 16-c.p. electric, or 1 3¼ cb. ft. gas burner.
Drawing room " " " "
Kitchen, 1 16-c.p., or 1 1½ cb. ft.
Scullery, 1 8-c.p., or 1 1½ cb. ft.
Four bedrooms, each 1 8-c.p., or 1 1½ cb. ft.
Two passages, each 1 8-c.p., or 1 1½ cb. ft.

These will be used, averaging all the year round, as follows:—

Drawing room, Dining room } One or other 4 hours per day.
Kitchen, 4 hours per day.
Scullery, say 2 hours per day.
Bedrooms, say ½ hour per day.
Passages, 4 hours per day.

Taking 16-c.p. lamps to consume 60 watts each, and 8-c.p. to use 33½ watts, and not forgetting the bye-passes of the gas lamps, we have the following consumptions per day:—

	Watt-hours.	Cubic feet. Burner.	Bye-pass.
Drawing room } Dining room }	720	13	+ 11
Kitchen	240	6	+ 5
Scullery	67	3	+ 5½
Four bedrooms	67	3	+ 23½
Two passages	266	12	+ 10
	1,360	37	+ 55
			92.
Cost of energy per day	5·44d.	3·3d.	
Cost of renewals per day	0·5d.	1·0d.	
Total cost per day	5·94d.	4·3d.	

The renewals are estimated on a life of 1,000 hours for 16-c.p. lamps and 500 hours for 8-c.p. lamps at 200 volts; and 3s. per annum per gas lamp. The ratio, it will be seen, far from 6 to 1, is only 1·4 : 1.

Now, be it noted, using standard burners, and adopting the most suitable sizes in each case, the foregoing arrangements are the nearest equivalents that can be made, using incandescent mantles throughout, for the inability of the gas burner to be sub-divided so far as the electric lamp is no reason why an unnecessarily large glow lamp should be used in the comparison. In fact, while for large candle-powers the gas lamp has the advantage, the possibility of sub-division appertaining to the glow lamp renders it unequalled for smaller powers. In the foregoing comparison no account is taken of the blackening of ceilings by gas, which may be taken to cost 1s. per annum per room multiplied by the average number of hours' use per day, or ·6d. on the basis assumed above; nor of the injury to paintings, decorations, books, &c., and to the health of the residents due to the noxious products of the gas burners.

Lastly, the price charged for the electrical energy is too high, on the assumed basis; for, taking the maximum demand rate at 7d. and 2d., and assuming that the maximum demand is 400 watts, the price would be 3½d. At 8d. and 1d., the price would be 3d., bringing the total cost down practically to equality with gas, and this is frequently the case in practice; consumers are often charged less than 3d. per unit.

These periodical outbursts on the part of the gas people do them no credit; but, fortunately, they do little harm to the electricity suppliers, as consumers have been so long accustomed in the past to gas meters and their audacious declarations, that they attach little importance to the allegations of the gas makers.

Calculator Board.—The article that appeared in our issue of August 28th, describing this ingenious board, omitted to give the name of the makers. In reply to many queries which have reached us, we may mention that all communications should be sent to Messrs. W. Watson & Sons, of 313, High Holborn, W.C.

Australian Federation Patent Bill.—We have received the following letter :—

"A Bill for an Act relating to patents for inventions was introduced into the Australian Senate, and received its first reading on June 26th. Through the courtesy of an Australian member of Parliament we have received an advance copy. This Bill should receive the attention of those of your readers who are interested in Australian patents.

"The subject of a single patent to cover the whole Australian Commonwealth has been one of lively interest ever since the Commonwealth became an accomplished fact, and we think this, the first step in this direction, of sufficient importance to warrant us in drawing the attention of your readers thereto. The Bill follows in general the British Act, while modifications are numerous and important. The principal provisions may be summed up as follows:—

"Patents to be granted for 14 years to cover the six States comprising the Commonwealth. Examination as to novelty is to be made to a limited extent. Actual working of the invention within the Commonwealth must be begun within five years, and must be continuous thereafter. Patent attorneys must be registered. Applications for patents may be filed by the inventor or his assignee, by representative of deceased inventor or assignee, or by a communicatee. Additional patents are provided for at half fees. Compulsory licenses are provided for. Existing State or Colonial patents remain without change in their scope.

"An important and valuable feature is found in Art. 57, according to which a patent is valid as to all good claims, notwithstanding it may contain one or more invalid claims. The working requirements cannot fail to appear to an Englishman to be a retrogade step, and it is to be hoped that those requirements will be eliminated.

"The cost of a patent under this new Bill to cover the six States comprising the Commonwealth will be about one-sixth the cost of taking out patents at the present time to cover the same area. There is, however, a fee of £8 payable before the actual issue of the patent, and a renewal fee of £5 before the expiration of the seventh year If enacted this session of Parliament the Act may take effect as early as next January, but it is more probable that it will not come into force earlier than in January, 1905.

"W. P. Thompson & Co.

"Patent Office, 6, Lord Street, Liverpool.

"*September 7th*, 1903."

Automobile Trials.—The Trials Organisation Committee of the Automobile Club have now made public the list of entries for their fifth annual reliability trials (1,000 miles). There is a total of 76 British cars, compared with 41 in 1902; the increase of foreign cars being from 43 to only 59. Thus it will be seen that the British increase is 85 per cent., while that of the foreign entries is only 37 per cent. Unfortunately, this cannot be taken as a guide to the prosperity of the English industry to the detriment of that on the Continent, but it rather indicates that the enormous French and German output is being more nearly absorbed by home demands. There is a net increase of 16 in the number of British firms in the list of competitors. Out of a total of 140 entries, only 10 are steam cars. There are no electric cars taking part in the trials.

Tramway Competition and Reduced Railway Receipts.—An example of the way in which the linking up of Lancashire towns by means of electric tramways is affecting railway passenger traffic has been afforded by the Oldham, Ashton-under-Lyne and Guide Bridge Railway Co., whose half-yearly meeting was held recently in Manchester. A falling off of £1,000 in the item of passenger and parcel traffic was reported. The chairman, Mr. Ed. Chapman, M.P., attributed it mainly to the detrimental effect of tramway competition. In third-class passengers alone a diminution was shown of 71,000 in the half-year. The shareholders, he said, might rely upon their doing everything that was possible to counteract this competition; at the same time it was disagreeable to find that while traffic was suffering so seriously, rates and taxes were advancing.

A Five Pound Note Too Much.—The Bethnal Green Guardians wanted to increase the salary of their electrical engineer, Mr. Broadley, from £110 to £130, and thence by annual increments of £10 to a maximum of £150 per annum, but the Local Government Board, which is sometimes very attentive to matters of small importance, could not possibly see its way to permit anything so iniquitous. It wrote to the Guardians saying that "as Mr. Broadley is also provided with rations, the proposed increase in his salary would involve a charge upon the Metropolitan Common Poor Fund in respect of his remuneration considerably in excess of the maximum allowed in respect of any similar officer elsewhere. Having regard to this fact, the Board would not feel justified in assenting to the Guardians' proposal, but with a view to meeting as far as possible their wishes in the matter, the Board is willing to approve of the increase of Mr. Broadley's salary to £125 per annum."

Appointments Vacant.—An assistant in the electrical engineering department at the Central Technical College, Exhibition Road (£150); assistant for the Croydon Mains Department (£100); switchboard attendant for Aston Manor; junior assistant engineer for Watford Electricity Works; teacher in electrical engineering for the South-Western Polytechnic. See our advertisement columns to-day.

Obituary.—The death is announced, at Croydon, as the result of an apoplectic seizure, of Mr. R. J. Hinton, who was, until last year, vice-chairman of the Electricity Committee of the Croydon County Council.

Newport Exceeds its Trading Powers.—The following interesting piece of news was published by the *Western Mail* on September 4th:—'It seems as though the Corporation of Newport has been pulled up pretty sharply in the matter of a bit of municipal trading. At a meeting of the Electricity Committee, a letter was read from Messrs. Turner & Co., solicitors, of London, stating that it had been brought to their notice that the Corporation were selling and supplying electric motors, and that it is *ultra vires* for the Corporation to do so without authority. In the absence of the Corporation having any Parliamentary powers to trade they (the solicitors) were instructed to take steps to prevent the continuance of such practice, unless there was an assurance from the Corporation that they will abstain from so trading in the future. The Corporation decided to reply that it was not the intention of the Corporation to continue the supply of motors."

In re Ferranti, Ltd., Manchester.—Mr. Tate was appointed receiver on behalf of Parr's Bank in *re* Ferranti, Ltd., and on Wednesday, before Mr. Justice Walton, sitting as Vacation Judge in the High Court of Justice, Mr. Bramwell Davis, K.C., applied on behalf of the trustee, Mr. Jones, and Parr's Bank, Ltd., who hold second debentures to the extent of £34,000, that a Mr. Whittaker might be joined with Mr. Tate as receiver-manager of the company. The company, he said, carried on a very large electrical business in Manchester, and it was absolutely necessary that some person on the spot should be appointed to manage and carry on the business. Mr. Tate, the present receiver and manager, was resident in London. He had nothing to say against him, but it was thought that somebody should be associated with him, like Mr. Whittaker, who was on the spot. Mr. Vernon, for the company, said he did not raise any objection, and there was, of course, no reflection on Mr. Tate. Mr. Bramwell Davis: Not the slightest. Counsel mentioned that leave had been given to borrow £20,000, of which £2,000 was to be applied at once for wages, &c. That had been done, and a further £2,000 would be required on Wednesday next. It was agreed that that sum should be paid as requested out of the remaining £18,000, subject to the supervision of the Court, and the appointment of Mr. Whittaker as additional receiver and manager at Manchester was sanctioned. Order accordingly. We believe that it is the hope of the directors that creditors will eventually be paid in full.

The Edison Battery.—In a recent interview with the New York *Times* Mr. Edison is reported as saying that one of his batteries had been in operation for three weeks in one of Altman's delivery wagons, and was doing all that he expected and claimed for it. The paper referred to says that the official test made of the new battery in the delivery wagon at Altman's showed that the old lead battery weighed 1,260 lbs. and had a maximum of 25 miles, while the Edison battery which replaced it weighed 650 lbs. and drove the wagon 36·8 miles. Besides this, the old battery occupied 12·8 cb. ft., while the Edison took up only 8·5 cb. ft.

Personal.—Mr. John A. Smeeton, A.M.I.Mech.E. (of Arthur Koppel) was to be married to Miss Grace Osborne, at St. Clement's Church, Ilford, yesterday.

Strike at Neasden Power Station.—The men employed by the British Westinghouse Co. on the new electric generating station at Neasden, now in course of construction for the Metropolitan Railway, went out on strike on Monday morning. The Westinghouse Co. states that the men appealed for higher wages, and this being refused, all the employés, who number over 300, struck work. The men allege that since the commencement of the work, their manager has used the American system of driving. Their special grievance is, they aver, that unless they are at their places on the scaffold at the moment the hooter sounds, and continue to work right up to the last minute, they are dismissed. The strike collapsed in the course of a few days.

A Question of Brakes.—Under this heading our esteemed contemporary, *Electrical Investments*, reports the recent inquiry into the tramcar accident at Ramsgate. One would expect a journal so closely identified with electric traction interests to know something about the subject; yet our contemporary says: "Owing to the trolley being off the wire the electric brake did not act," and goes on to remark that "The electric brake is wonderfully effective while the motorman has electric power at his command, but any accident to the trolley may, as this accident illustrates, render it inoperative." It would be a poor sort of electric brake that depended upon the trolley being in place!

British Association at Southport.—Prof. Dewar, the retiring president, announced on Wednesday that the Council recommended the acceptance of the invitation to hold the 1905 meeting in South Africa. A decision will be given to-day. Next year's president will be Mr. Balfour, the Prime Minister, and the meeting will be at Cambridge. The day's proceedings were confined to the delivery of his presidential address by Sir Norman Lockyer, and a meeting of the General Committee.

THE CENTRAL STATION ENGINEER.

The following appointments have been made in connection with the Bexley Council's Electricity Undertaking:—Mr. H. Knorr as senior charge engineer; Mr. J. D. Laws as junior charge engineer.

Mr. S. F. Smith, of Taunton, and Mr. Irish, of Weymouth, have been appointed as assistant engineers at the Portsmouth Corporation electricity works.

On September 3rd Mr. E. M. Hollingsworth, Corporation electrical engineer at St. Helens, was married to Miss E. H. Springfellow at the Church of Our Lady, Portico, near St. Helens. The numerous presents included a silver tea and coffee service from the Corporation electricity staff.

A very pleasant ceremony took place last Saturday evening at Llanarth Street Electricity Works of the Newport Corporation, when Mr. A. H. Felton was the recipient of a handsome marble clock presented to him by the staff of the electricity department, on the occasion of his marriage. Mr. H. Collings Bishop, borough electrical engineer and tramways manager, made the presentation.

The Barnsley T.C. has accepted the resignation of Mr. Bastow, resident electrical engineer, with regret, and has appointed Mr. Barker, assistant engineer, to succeed him at £225 per annum, rising to £250 next year.

Mr. Storey, the electrical engineer at Torquay, it appears, had an offer from Messrs. Davis & Soper, of London, on behalf of the Port Elizabeth municipality, but his Committee as a matter of urgency recommended the T.C. to increase his salary forthwith from £300 to £350. Mr. Storey has given the Torquay Committee an undertaking that he will not apply for further increase of salary within a year or two.

Mr. W. B. Woodhouse, A.M.I.Mech.E., A.M.I.E.E., has resigned the position of resident engineer to the Newcastle Electric Supply Co. to take up that of chief resident engineer to the Yorkshire Electric Power Co. The Yorkshire Co. has an area of supply of 1,800 square miles, covering one of the busiest manufacturing parts of England.

NEW COMPANIES REGISTERED.

Electro-Post Railway Co., Ltd. (78,489).—This company was registered on September 4th, with a capital of £100 in £1 shares, to construct, repair, maintain and operate installations, cables, wires and other works of every kind for the generation, supply, distribution and employment of electricity for motive power, lighting, heating or other purpose, to manufacture and deal in engines, motors, machinery, rolling stock and materials for use in connection therewith, &c. The first subscribers (each with one share) are:—S. H. Penwarden, 13, Comely Road, Walthamstow, clerk; W. G. Yeoman, 23, Muschamp Road, East Dulwich, clerk; G. E. Sanders, Bloomfield Lodge, Larkfield Road, Richmond, Surrey, clerk; W. H. Walford, 38, Worley Road, Leytonstone, clerk; E. R. Church, 2, Kepley Road, Clapham, S.W., clerk; T. Winter, 8, Montem Road, Forest Hill, S.E., secretary; and F. J. Stewart, 29, Ashchurch Grove, W., clerk. No initial public issue. Table "A" mainly applies. In the event of all the shares not being subscribed by December 31st, 1903, the company is to be dissolved.

Aërozone, Ltd. (78,472).—This company was registered on September 2nd, with a capital of £12,000 in £1 shares, to acquire from J. Harris letters patent granted for Great Britain, Ireland, and Isle of Man, No. 17,805 of 1901; for France No. 320,661 of 1902; and for Belgium No. 162,872 of 1902, relating to improvements in the purification of air, and to carry on the business of an electric company, or purifiers of air, electricians, mechanical, electrical and ventilating engineers, manufacturers and suppliers of ozone, and electricity for light, heat, motive power, or otherwise. The first subscribers (each with one share) are:—W. L. Grimwade, 18, Foxham Road, Holloway, merchant; A. E. Sherman, 8, Tredegar Square, Bow, electrician; G. E. B. Kilner, 4, 5 and 6, Gt. St. Helens, E.C., solicitor; R. Burn, 50, Old Broad Street, E.C., engineer; R. Jones, 282, Bishopsgate Street Without, E.C., colonial broker; J. Abrahams, 47, Torrington Square, W.C., agent; and T. G. McEwen, 8, Union Court, E.C., chemical engineer. Minimum cash subscription, £4,000. The number of directors is not to be less than three nor more than seven; the first are J. Harris and others to be appointed by the subscribers; qualification (except J. Harris), £100; remuneration, £50 each per annum.

British Electric Calibrated Fuse Co., Ltd. (78,488).—This company was registered on September 4th, with a capital of £3,000 in £1 shares, to adopt a certain agreement and to carry on the business of manufacturers of, and dealers in, electric and other fuses and electric accessories and appliances, electricians, electric engineers and contractors, manufacturers of rubber and rubber goods, &c. The first subscribers (each with one share) are:—W. Macdonald, 118, Queen Victoria Street, E.C.; G. E. Heyl-Dia, Birk Cragg, Stretton, Ches., engineer; O. N. Avent, Grappenhall, Ches., gentleman; A. O. Hoercher, 1, Mortimer Road, Kensal Rise, W., clerk; A. G. Norris, 144, Minard Rord, Catford, S.E., clerk; D. B. Macbride, 118, Queen Victoria Street, E.C., engineer; and W. S. Rouse, Rayleigh Rectory, Essex, tutor. No initial public issue. The number of directors is not to be less than two nor more than five; the first are G. E. Heyl-Dia and W. Macdonald (both permanent); qualification, 50 shares.

Glasgow Electric Crane and Hoist Co., Ltd. (5,440).—This company was registered on September 4th, with a capital of £100,000 in £10 shares, to acquire the patents and patent rights for Great Britain and Ireland, granted to the Benrather Maschinenfabrik Actien Gesellschaft, and the exclusive right for a period of 10 years to sell in Germany machinery in accordance with those patents, and to carry on in the United Kingdom, Germany, and elsewhere the business of makers of and dealers in electric and hydraulic cranes, hoists, lifts, and all kinds of lifting and conveying machinery, general and mechanical engineers, iron and brass founders, boiler makers, builders, painters, &c. The first subscribers (each with one share) are:—W. Beardmore, Parkhead Forge, Glasgow, steel manufacturer; J. R. Johnston, 160, West George Street, Glasgow, writer; J. B. Johnston, 160, West George Street, Glasgow, clerk; J. Andrews, 160, West George Street, Glasgow, writer; F. W. Harvey, 160, West George Street, Glasgow, writer; A. M. Mitchell, 160, West George Street, Glasgow, writer; and F. Murray, 160, West George Street, Glasgow, clerk. The number of directors is not to be less than four nor more than nine; the first are W. Beardmore, D. Vickers, A. D. Williamson, and J. Hamilton; qualification, £1,000; remuneration as fixed by the company. Registered office, Parkhead Forge, Glasgow.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Woking Electric Supply Co., Ltd. (46,175).—Issue on July 31st of £200 debentures, part of series created November 2nd, 1899, to secure £25,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £22,350.

Frank Suter & Co., Ltd., electrical engineers, London (57,193).—A memorandum of satisfaction to the extent of £1,000 of debentures dated April 18th, 1901, securing £7,000, has been filed.

Royce, Ltd., electrical engineers, Manchester (63,871).—Issue on August 17th of £5,600 debentures, part of series created May 27th, 1903, to secure £25,000, charged on the company's undertaking and property, present and future, except uncalled capital. Trustees: Law Guarantee and Trust Society, Ltd., 49, Chancery Lane, W.C. Previously issued of same series: £17,100.

T. C. Welding & Co., Ltd. electrical fittings manufacturers, Liverpool (70,309).—Issue, on August 22nd, of £1,200 third mortgage debentures, part of series created July 9th, 1903, to secure £1,500, charged on the company's undertaking and property, present and future, including uncalled and unpaid capital. No trustees. Previously issued of same series: £300.

Sherard Cowper-Coles & Co., Ltd., electricians, London (67,136).—Issue, on August 14th, of £500 debentures, part of series created by resolutions of December 3rd, 1901, and February 7th, 1902, to secure £6,500, charged on the real and personal property of the company, present and future, except uncalled capital. No trustees. Previously issued of same series: £5,675.

Langdon-Davies Motor Co., Ltd. (55,830).—Issue, on August 13th, of £1,500 debentures, part of series created October 15th, 1902, to secure £6,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £3,300.

George Bray & Co., Ltd., electrical engineers, Leeds (76,185).—A trust deed, dated August 27th, 1903, to secure £40,000 debenture stock, created February 25th, 1903, has been registered. Property charged: Freehold property known as Bagley Works, Leeds; certain inventions and patents and the company's other assets, present and future, including uncalled capital. Trustees: G. Bray, Belmont, Headingley, Leeds; and J. W. Close, Greek Street, Leeds.

ELECTRICITY SUPPLY ACCOUNTS.

Burnley Corporation Tramways.

We give this week an analysis of the returns of the Burnley Tramways. The routes are nearly all reconstructed steam lines, which were originally worked by the Burnley and District Tramways Co., and in the case of those portions lying in the Urban Districts of Brierfield and Padiham, the parish of Reedley Hallows, and the Nelson Corporation's area, are worked on a lease. The maximum gradient is 1 in 17.

Energy is obtained from the Corporation lighting station, and from the Nelson Corporation electricity works, at prices of 1½d. and 2d. per unit respectively.

The tramways manager is Mr. H. Mozley, and the engineers responsible for the electrical equipments at Burnley and Nelson are Messrs. R. Birkett and A. Fraser, respectively.

Period covered by returns ...	12 months	13 months
Date ending	March 31st, 1903	March 31st, 1902
„ of opening	December, 1901, to March, 1902	
Length of route	7 miles. Authorised, 11 miles	
Total length of track	14 miles. Authorised, 20 miles	
Car-miles run	697,785	305,176
Passengers carried per annum	6,131,050	3,042,845
Capital expenditure to date ...	£106,450	£104,554
Traffic receipts...	£36,515	£18,501
Working expenses	£25,035	£13,902
Gross profit	£11,480	£4,699
Income per car-mile	12·52d.	14·38d.
Working expenses per car-mile	8·61d.	9·69d.
Interest and sinking fund per car-mile	2·32d.	—
Rental of leased tramways ...	·64d.	—
Total expenses per car-mile...	11·57d.	—
Profit or loss per car-mile ...	·95d.	—
Cost of energy per car-mile...	2·90d.	—
Average fare per passenger ...	1·41d.	1·42d.
Revenue per mile of route ...	£5,216	—
Expenditure per mile of route	£3,576	—
Number of units used—		
Burnley section	891,693	151,445
Nelson section	176,847	2,493
Total...	1,068,540	153,938
Units per car-mile	1·53	1·54

The change over to electric traction has been marked as usual by a decrease in the proportion of expenses to receipts, from 73 per cent. to 68·5 per cent. Last year two-thirds of the working expenses were debited to steam haulage. The mileage and passengers carried have more than doubled, and the profit shows 140 per cent. increase on last year's amount.

Analysis of Working Expenses.

For year ending March 31st, 1903.	Gross.	Per car-mile.
Traffic wages	£8,102	2·78d.
Electrical energy	8,432	2·90d.
Management	1,137	·39d.
Depôt expenses	1,333	·47d.
General expenses including tickets, law, insurance, compensation, and general establishment	914	·36d.
Rent, rates, and taxes	1,324	·45d.
Repairs and Maintenance.		
Track	2,981	1·03d.
Overhead equipment including telephones	243	·08d.
Buildings, plant, and machinery ...	169	·05d.
Munn's Depôt. (Part cost.) ...	300	·10d.
Total ...	£25,035	8·61d.

The working expenses stand considerably higher than the average, the principal contributor being the item for energy. In common with other hilly routes, the units per car-mile are high, and in this case the purchase price (2d. per unit). helps to swell the cost per car-mile to nearly 3d. The income per car-mile is above the average, and enabled a gross profit of £11,480 to be earned, out of which interest on loans and sinking fund absorbed £6,721; rental of leased lines, £1,867 (equivalent to ·64d. per car-mile); sundries, £317; and the balance, £2,575, was credited to the reserve fund.

Profit Statement.

Interest on loans	£3,383
Sinking fund...	3,338
Rental of lines in Padiham, Reedley Hallows, Brierfield, and Nelson	1,867
Sundry creditors	317
To reserve fund	2,575
	£11,480

CITY NOTES.

The Electric Railway & Tramway Carriage Works, Ltd.

The directors' report to be submitted to the meeting to be held at the offices, Strand Road, Preston, on Thursday, September 24th, at 12 noon, reads as follows:—

"The directors herewith submit the balance-sheet of the company's trading for the year ending June 30th, 1903. The works have been efficiently maintained as regards buildings and machinery, the cost of which has been charged against revenue. After paying debenture interest amounting to £2,500, and charging £5,096 3s. 9d. for depreciation, the profit for the year is £16,594 14s. 11d., to which must be added £2,832 3s. 8d. brought from last year, making a total of £19,426 18s. 7d. The directors recommend that this amount be dealt with as follows:—

To carry to general reserve fund	£2,000	0	0
To pay a dividend of 8 per cent., less income-tax, for the year ending June 30th, 1903	12,000	0	0
To carry forward to next year	5,426	18	7
Total ..	£19,426	18	7

"In accordance with the articles of association, two directors retire, viz., Mr. Richardson and Mr. Prestwich, and being eligible offer themselves for re-election."

Stock Exchange Notice.—The Committee has appointed a special settling day as under:—Wednesday, September 16th—Metropolitan Electric Supply Co., Ltd., 71,106 4½ per cent. cumulative preference shares of £5 each, fully and partly paid, Nos. 1 to 71,106; and has ordered same to be quoted in Official List.

Prospectus.—The Weston-super-Mare and District Electric Supply Co. is before the public until Monday next with an issue of £35,000 4½ per cent. first mortgage debenture stock, and 34,930 6 per cent. cumulative preference shares. The issue is made for the purpose of discharging the balance of liabilities on capital account (£68,618), which includes £11,000 borrowed from the B.E.T. Co.

STOCKS AND SHARES.

Wednesday Evening.

Business shows little indication of returning to the Stock Exchange, notwithstanding the close of the holiday season and the City tradition that September is the month in which trade should begin to revive. The long-continued flatness in Consols acts as a wet blanket to all the investment departments, and the new 4 per cent. Bank Rate reconciles the public to allowing their money to remain on deposit at their bankers. Moreover, it is far from certain whether the Rate will not have to be raised yet further, and the prospect of 5 per cent. is unpleasant to the Stock Exchange. The sections with which we have to deal display their wonted steadiness, and amongst weak markets round the House the strength of electrical securities stands out as a pleasant contrast, although this is the time of year when quotations should begin to move upwards.

To issue a new undertaking at such a time as this is in itself a mark of high courage, and other promoters must regard with mingled feelings the new Weston-super-Mare and District Electric Supply Co., the application lists for which will close on Monday next, September 14th. The whole amount of the capital offered has been underwritten by the British Electric Traction Co., but the affair is such a small one that public interest is scarcely likely to be large. The share capital amounts to but £80,000, and of this £34,930 is offered in Preference shares, with about the same sum in Debenture stock. No market has been made in either issue up to the time of writing.

City of London Ordinary and County Ordinary are both a trifle depressed, but Metropolitans maintain a steady tone, the award in the Sardinia St. Station case being rather relished by the market. The demand for Preference shares and Debenture stocks in this section is unabated, and the supply of the best kinds diminishes daily. Metropolitan new Preference have been accorded a special settlement and official quotation: the actual price is ¼ to ⅜ premium. Several of the low-priced properties have come into request. Blackheath and Greenwich are wanted, for instance, and vague rumours are in circulation with regard to this company and a Crystal Palace undertaking. Edison & Swan have found supporters in a timid way, the price being called about 2s. 6d. per share. It is long since a buyer appeared with a bid even of that value. Amongst the miscellaneous concerns, Electric Constructions are a little more active at 1⅛. The high-priced supply shares continue in quiet request.

Direct United States Telegraph shares have rallied 5s., but the Anglo-American group is motionless, and the only other change in the telegraph market is a fresh fall of ¼ in West India and Panama First Preference shares. Globe Ordinary are also down to the same extent, a few sellers coming in on the eve of the settlement. Telephone varieties are almost equally motionless, a recession of a point in National 3½ per cent. Debenture stock constituting the one alteration, although the Deferred and Preferred change hands fairly frequently at prices within the wide margins quoted by the Stock Exchange Official List.

Electrical Railway Stocks are marking time. There was a better tone in City and South London, although this failed to hold, and the stock is 1 per cent. down. The Central London descriptions also seem somewhat inclined to weaken after the curious experience of a trainful of passengers last Tuesday night. The two older Undergrounds are moving in opposite directions, District stock being lower and Metropolitan slightly harder on the week; the last-named improvement is due to the attention bestowed upon the company in reference to the coming electrification, which, it is thought, will prove its tangible advantages immediately the new system gets to work. Meanwhile, however, it should be noted that entire harmony does not reign between the two companies.

British Westinghouse Ordinary shares are 7, and the Preference 5⅞. A private issue of 4½ per cent. Debenture stock by the British Thomson-Houston Co. has recently been made, and the quotation is about 105. For a well-secured First Mortgage Debenture this price does not seem expensive. British Electric Traction Preference slipped back ¼ on the inclusion of the new shares in the official quotation. Potteries Ordinary and Preference are both dull at 9½, a movement that has been apparently overlooked by a sensational daily paper with a genius for springing fresh American surprises upon the various industries of this country. North Metropolitan Trams at 3 show a fall of 10s., and London United Debenture stock, after being marked down a point, was reinstated at 106. Cape Electrics have firmed up to 2¼, and at 78⅛ British Columbia Electric Railway Deferred is another 2 points higher.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Sept. 2nd.	Closing Quotations Sept. 9th.	Business done week ended Sept. 9th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2½— 3½	2½— 3½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
738,840	Anglo-American Telegraph	Stock	3½%	6l3.	60/6	47 — 50	47 — 50	47	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	90 — 92	90 — 92	91⅞	90½
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8 — 8½	8 — 8½	8	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	150 —160	150 —160	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	93 — 96	93 — 96	95½	94
16,000	Cuba Telegraph	10	4½%	4 %	6¾%	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	16½— 17½	16⅞— 17½	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3½	2½— 3½	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
30,000	Do. do. 4½ % Debs.	50	..	..	..	97 —101 %	97 —101 %	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10 — 10½	10⅜— 10⅝	10⅜	10⅜
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	124 —129	124 —129	127	125½
1,955,555	Do. 3½ % Pref. Stock	100	..	..	..	90 — 93	90 — 93	91⅞	91½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	107½	107½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 12½	12 — 12½	12½	..
820,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —107	104 —107	106	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	98 —101	98 —101	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103 %	100 —103 %	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	9 — 9½	8⅞— 9⅛	9⅛	8⅞
180,042	Do. do. 6 % Pref.	10	..	..	..	12⅞— 13⅛	12⅞— 13⅛	12⅞	..
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22 — 23	22 — 23	..	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	36 — 39	36 — 39	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	97 —101 xd	97 —101	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	100 —102	100 —102	101⅛	100⅜
1,966,667	Do. do. Def. Stock	100	..	..	4⅓%	78 — 80	78 — 80	78⅛	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13⅜	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5¼	5 — 5¼	5 1/16	5⅛
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 98	95 — 97	96¼	94½
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	101 —103	102½	101½
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅛— ⅜	⅛— ⅜	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,839	Reuter's	8	5 %	5 %	..	6¼— 7½	6¼— 7½	..	..
3,303	Submarine Cables Trust	Cert.	..	..	..	116 —121	116 —121	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5½— 6	5½— 6	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅞— 5⅛	4⅞— 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	104 —107	104 —107	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	12 — 12⅛	12 — 12⅛	12⅛	12⅛
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	98 —101	98 —101	99½	..
88,321	West India and Panama Telegraph	10	¼%	..	..	7/16— 9/16	7/16— 9/16	..	..
84,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6⅛— 6⅜	6 — 6⅛	6⅛	6 1/16
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3½— 4½	3½— 4½	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	98 —101	98 —101	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	83 — 87	83 — 87	85	84⅜
100,000	British Electric Traction	10	9 %	9 %	8 %	12½— 13	12½— 13	12 5/16	12⅜
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11⅞— 12⅛	11⅞— 12	11 1/16	11¼
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 —125	122 —125	..	..
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6¾— 7⅛	6¾— 7⅛	6 13/16	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —106	102 —106	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	7/16— ½	7/16— ½	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	¾— 1	1— 1¼	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1 — 1⅛	1 — 1⅛	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	97 —100 xd	97 —100	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
85,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11¼— 12½	11¼— 12½	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5½— 5⅞	5½— 5⅞	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	98 —101	98 —101	100⅛	99⅛
494,098	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	100 —103	100 —103	101⅛	..
494,993	Do. do. Def. do.	Stock	..	4 %	4 %	101 —104	101 —104	101⅛	..
1,830,000	City and South London Railway	Stock	1½%	2 %	3⅛%	59 — 61	59 — 61	60	59⅜
85,000	Crompton & Co., Nos. 1 to 85,000	8	8 %	7½%	5 %	2 — 2½	2 — 2½	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	101 —104	100 —104	101½	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1½— 2⅜	1½— 2⅜	..	..
844,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	71 — 75	71 — 75	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 80	75 — 80	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅜— 1⅝	1⅜— 1⅝	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2⅜— 3	2⅜— 3	..	..
82 500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	98 —101	98 —101	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	9½— 10	9½— 10	9⅝	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	99 —102	99 —102	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	13½— 14½ xd	13½ - 14½ xd	..	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5½ xd	5 — 5½ xd	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111 xd	107 —111 xd	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	10 %	18½— 19½	18½— 19½	..	..
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	5½— 5⅝	5 — 5½	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½— 10¾xd	10½— 10¾	..	..
37,350	Telegraph Construction and Maintenance.	12	17½%	20 %	20 %	34 — 37	34 — 37	37	35½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	100 —103	100 —103	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	95 — 98	95— 98	..	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

National Electric Free Wiring, ⅛—¼.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14¼—14⅞.
Do. do. Pref. (£11 pd.), 10—10⅛.

Bank rate of discount 4 per cent. (September 3rd, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Sept. 2nd.	Closing Quotations Sept. 9th.	Business done week ended Sept. 9th, 1903. Highest.	Lowest
		‡							
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	1	..	..	..	⅝— ⅞	⅝— ⅞	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	118 —121	118 —121	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	6 %	8 %	8 %	10¼— 11	10¼— 11	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10¼— 10⅜	10¼— 10⅜	10⅜	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9½	9 — 9½	9⅜	9⅜
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5¼— 6	5¼— 6	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4¾— 5	4¾— 5	4⅞	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	104 —106	..	..
44,436	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4¾%	5¾— 6¼	5¾— 6¼	..	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —111	108 —111	110	109½
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	10⅜— 11	10⅜— 11	10⅝	10⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —127	122 —127	..	..
900,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	8 — 9 xd	7½ — 8½	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11½— 12½xd	11½— 12½	..	..
400,000‡	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red ..	..	..	..	..	109 —112	109 —112	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6½— 7	6½— 7	6⅝	6½
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6¼— 6⅝	6¼— 6⅝	6⅜	6⅛
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	107 —110	107 —110	107¼	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10½— 11½	10½— 11½	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	103 —106	103 —106	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	2 — 2½	2 — 2½	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5½— 6 xd	5½— 6	..	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red ..	Stock	..	..	..	100 —102	100 —102	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6⅛%	7⅛%	17½— 18½	17½— 18½	17⅞	..
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	108 —112	108 —112	109	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 —100	97 —100	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	13 — 14	13 — 14	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14⅛%	14⅛%	14⅛%	15¼— 16½	15½— 16½	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3½— 3⅝	3½— 3⅝	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1¾%	3¾— 4¼	3¾— 4¼	..	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	5 — 5½	5 — 5½	..	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5½	5 — 5½	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	13 — 14	13 — 14	13¹¹/₁₆	13⅞
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6½	6 — 6½	..	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, September 9th.

	CHEMICALS, &c.	Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric .. .. .. per cwt.	5/-	..
a	,, Nitric .. .. per cwt.	22/-	..
a	,, Oxalic .. .. per cwt.	32/-	..
a	,, Sulphuric .. .. .. per cwt.	5/6	..
a	Ammoniac, Sal .. .. .. per cwt.	42/-	..
a	Ammonia, Muriate (crystal) .. per ton	£33 10	..
a	,, ,, ... per ton	£30	..
a	Bleaching powder .. .. .. per ton	£4 10	..
a	Bisulphide of Carbon .. .. per ton	£15	..
a	Borax .. .. per ton	£13	..
a	Benzole (90 %) .. .. .. per gal.	7/-	..
a	,, (50/90 %) .. .. .. per gal.	5/6	..
a	Copper Sulphate .. .. .. per ton	£20	..
a	Lead, Nitrate .. .. .. per ton	£24	..
a	,, White Sugar .. .. .. per ton	£31	..
a	,, Peroxide .. .. .. per ton	£27 10	..
a	Methylated Spirit .. .. .. per gal.	2/6	..
a	Naphtha, Solvent (90% at 160° C). per gal.	5/6	..
a	Potash, Bichromate, in casks .. per lb.	3d.	..
a	,, Caustic (75/80%) .. .. per ton	£24	..
a	,, Bisulphate .. .. per ton	£35	..
a	Shellac .. .. per cwt.	157/-	..
a	Sulphate of Magnesia .. .. per ton	£4 10	..
a	Sulphur, Sublimed Flowers .. per ton	£6 10	..
a	,, Recovered .. .. per ton	£5 10	..
a	,, Lump .. .. .. per ton	£5	..
a	Soda, Caustic (white 70 %) .. per ton	£10 15	..
a	,, Crystals .. .. .. per ton	£3	..
a	,, Bichromate, casks .. .. per lb.	2¼d.	..
	METALS, &c.		
b	Aluminium Ingots, in ton lots .. per ton	£130	..
b	,, Wire, in ton lots .. per ton	£168	..
b	,, Sheet, in ton lots .. per ton	£166	..
p	Babbitt's metal ingots .. .. per ton	£43 to £145	..
c	Brass (rolled metal 2' to 12') basis per lb.	7d.	..
c	,, Tube (brazed) .. .. per lb.	8⅜d	..
c	,, ,, (solid drawn) .. per lb.	7¾d.	..
c	,, Wire, basis .. .. .. per lb.	7⅞d.	..
c	Copper Tubes (brazed) .. .. per lb.	9¼d.	..
c	,, ,, (solid drawn) .. per lb.	9⅜d.	..
g	Copper Bars (best selected .. per ton	£75	..

	METALS, &c. (*continued*).	Latest Price.	Week's Inc. or Dec.
g	Copper Sheet .. .. .. per ton	£75	..
g	,, Rod .. .. per ton	£75	..
e	,, (Electrolytic) Bars .. per ton	£66	..
e	,, ,, Sheets .. per ton	£76	..
e	,, ,, Rod .. per ton	£68	..
e	,, ,, H.C. Wire per lb.	8d.	..
f	Ebonite Rod .. .. .. per lb.	3/8	..
f	,, Sheet .. .. .. per lb.	8/-	..
n	German Silver Wire .. .. per lb.	1/6	..
h	Gutta-percha fine .. .. .. per lb.	8/-	..
h	India-rubber, Para fine .. .. per lb.	4/3 to 4/4½	inc.
i	Iron, Charcoal Sheets .. .. per ton	£18	..
i	,, Pig (Cleveland warrants) per ton	46/11	½d. inc.
i	,, Forgings, according to size per ton	From £11	..
i	,, Scrap, heavy .. .. per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 .. per ton	£9 15	..
g	Lead, English Ingot .. .. per ton	£11 10 to £11 12 6	5s. inc.
g	,, ,, Sheet .. .. per ton	£13	..
m	Manganin Wire No. 28 .. .. per lb.	8/-	..
g	Mercury .. .. per bot.	£8 7 6	2/6 dec.
d	Mica (in original cases) small .. per lb.	4d. to 1/6	..
d	,, ,, ,, medium per lb.	2/6 to 3/9	..
d	,, ,, ,, large .. per lb.	4/- to 7/9	..
p	Phosphor Bronze, plain castings per lb.	1/- to 1/2½	..
p	,, ,, rolled bars & rods per lb.	1/1 to 1/4	..
p	,, ,, strip & sheet per lb.	From 1/2	..
o	Platinum .. .. per oz.	£4	..
p	Silicium Bronze Wire .. .. per lb.	10d. to 1/-	..
i	Steel, Magnet, acc'd'g to desc'p'n per ton	£58	..
i	,, ,, in bars	£15 to £40	..
g	Tin, Block .. .. per ton	£124 to £126	inc.
g	,, Foil .. .. per lb.	1/6	..
n	,, Wire, Nos. 1 to 16 .. .. per lb.	1/7	..
p	White Anti-friction Metals—		
	"White Ant" brand .. per ton	£42 to £65	..
j	Yarns, 2/10s Grey Cotton, on sp'ls per lb.	8d.	..
j	,, 6 lea. Flax .. .. .. per lb.	5⅜d.	..
j	,, 8 ply 10 lbs. Russian .. per lb.	4⅛d.	..
j	,, 10 lbs. Russian, single .. per lb.	4⅛d.	..
j	,, 180 lbs. Jute rove .. per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.) per ton	£24 5	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Hill & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	Sep. 5	1,312	+169	18,756	+ 2,383	10	—
	Birmingham	,, 5	5,199	+ 62	181,883	+ 8,244	—	—
	Bournemouth	,, 2	1,430	—	—	—	10½	—
	Blackburn	June 26	909	—286	11,668	+ 674	12½	+1½
	Blackpool	Sep. 3	1,625	—447	27,370	+ 377	8½	—
	Blackpool and Fleetwood	,, 5	1,868	—287	14,087	+ 307	7⅝	—
	Bolton	,, 6	1,913	+184	43,774	+ 5,836	25	—
	Bradford	Aug. 23	4,267	+579	81,276	+13,000	41	+4
	Brighton	Sep. 6	1,107	— 6	36,185	—	6½	—
	Bristol	,, 4	5,199	#221	—	—	28	—
	Burnley	,, 5	844	+ 89	—	—	7½	—
Brit. Elec. Trac. Co.	Barnsley District	Aug. 28	257	—	6,257	—	4½	—
	Devonport	,, 28	482	— 15	15,337	+ 425	5	—
	Dudley—Stourbridge	,, 28	988	+ 14	28,692	+ 2,913	18⅝	—
	Gateshead	,, 28	954	+ 57	29,671	+ 4 525	10½	+ ½
	Gravesend—Northfleet	,, 28	324	+124	8,140	+ 468	3½	—
	Greenock—Pt. Glasgow	,, 28	652	+ 43	18,720	+ 1,494	7½	—
	Hartlepool	,, 28	326	— 50	9,223	+ 413	6½	+½
	Kidderminster	,, 28	148	— 12	4,541	+ 205	4½	—
	Merthyr	,, 28	208	— 18	6,789	— 247	3	—
	Middleton	,, 28	419	+ 23	11,248	+ 1,360	8½	—
	Oldham—Ashton	,, 28	560	— 11	19,745	+ 1,186	8	—
	Peterborough	,, 28	178	—	5,090	—	—	—
	Poole	,, 28	442	+ 69	10,471	+ 1,606	3½	—
	Potteries	,, 28	1,579	+ 44	53,122	+ 2,869	24½	—
	Rothesay	,, 28	325	— 24	5,597	+ 1,640	2½	—
	Sheerness	,, 26	97	—	1,959	—	2½	—
	Southport	,, 28	385	+ 36	10,845	+ 1,995	5½	—

* Compared with the corresponding period of 1902.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.
B.E.T. Co.	South Staffordshire ..	Aug. 28	1 096	+320	30,328	+ 3,684	21½
	Swansea	,, 28	604	+ 12	17,888	+ 1,518	5½
	Taunton	,, 28	70	— 15	2,123	— 192	1½
	Tynemouth	,, 28	477	— 30	11,198	+ 1,014	3½
	Weston-super-Mare ..	,, 26	315	— 68	4,307	— 381	2½
	Wolverhampton Dist.	,, 28	427	+101	13,529	+ 6,776	10½
	Wrexham	,, 28	143	—	3,098	—	—
	Yorks. Woollen Dist. ..	,, 28	457	—	9,265	—	6
	Cardiff	Sep. 5	2,037	+413	46,161	+14,253	14
	Chatham & District Co.	,, 3	734	+ 73	18,642	+12,515	8·53
	Dover	,, 5	310	— 10	8,059	+ 66	3
	Dublin	,, 4	5,505	—186	56,582	+ 6,108	46
	East Ham	,, 5	758	+223	16,071	+ 5,077	5
	Glasgow	,, 5	13,625	+1040	187,356	+20,538	65
	Hull	,, 5	1,847	+ 64	42,074	+ 1,925	11
	Ilkeston	,, 2	192	—	—	—	4
	Isle of Thanet	,, 5	1,508	—193	25,715	— 933	10½
	Leeds	,, 5	5,452	+123	131,049	+ 7,524	41
	Liverpool	Aug. 22	10,473	+ 603	339,684	+12,141	100
	Manchester	Sep. 5	11,590	+6078	271,957	+171,672	72
	Newcastle	,, 5	3,390	+458	—	—	17
	Portsmouth	Aug. 24	2,390	—191	—	—	29
	Salford	,, 24	3,856	+1135	79,469	+24,703	30
	Southampton	,, 13	1,270	—	—	—	9
	Sunderland	Sep. 6	1,374	+ 47	59,549	+ 810	20
	Central London Railway	,, 5	5,493	—170	60,928	— 1,948	6
	City and S. London Ry.	,, 6	2,415	— 242	24,274	— 3,061	6½
	Dublin and Lucan Elwy.	,, 6	165	+ 17	1,500	+ 60	6½
	Liverpool Overhead Ry.	,, 6	1,714	+106	17,294	+ 938	6

ON A NEW METHOD OF TUNING WIRELESS TELEGRAPH STATIONS BY MEANS OF THE "MULTIPLIER."*

BY COUNT ARCO.

(*Continued from page* 401.)

IV.—PRACTICAL APPLICATION OF THE METHOD.

We will now describe an experiment in tuning, or a measurement of electric waves on a larger scale which was carried out in the winter of 1901-2 between the experimental stations at Oberschöneweide, near Berlin, and the Schiffbauerdamm offices of the A.E.G. These stations may perhaps be remembered in connection with the paper read by Prof. Slaby on December 22nd, 1900, in which he for the first time clearly explained the principles of wave formation in wireless telegraphy, and gave a demonstration of practical duplex working.

The arrangement of the aerial wires at Oberschöneweide is shown in plan and elevation in fig. 7. Between the summits of two

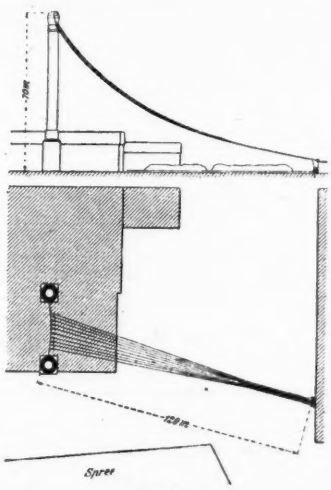


FIG. 7.

chimneys 70 m. high and 25 m. apart a hemp rope was stretched horizontally. To this were attached, at distances of 2 m., 10 conductors, each 140 m. long, and running in a sloping direction down to the experiment room. Each conductor was a bare copper strand consisting of seven wires, each 0·28 mm. in diameter. The horizontal distance of the experiment room from the base of the chimneys is about 120 m. The aerial conductors were, in this series of experiments, earthed at the bottom through an inductance coil of the following dimensions:—

Diameter of coil = 30.5 cm.

External diameter of the rubber-covered strand 7 × 0·28 mm.

This system of aerial conductors was electrically excited in various ways, and the wave-length determined by the "unloaded" (without condenser) multiplier, whilst the tuning of the receiver was effected by means of the "loaded" multiplier.

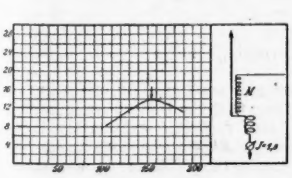


FIG 8.

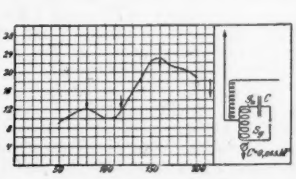


FIG. 9.

Then, as a check on the value so found, the tuning was verified by trial with the receiving apparatus at the Schiffbauerdamm station, 12·5 km. distant.

Figs. 8, 9 and 10 show in each case:—

1. The method of transmitter excitation and of joining up the multiplier.

2. The curves of the tuning values obtained, the abscissæ representing the lengths in metres of the windings in circuit, and the ordinates the potential differences at the upper end of the coil in millimetres of spark length.

3. The vertical arrows show the values obtained by actual experiment with the receiving apparatus at Schiffbauerdamm.

We observe in fig. 8 (old Marconi excitation) that the tuning found with the multiplier gives $(s_v + s_e) = 154$. This maximum is clear and sharp. The tuning, controlled by means of the receiving apparatus, which gave the best reception was—

$$\begin{aligned} s_v &= 135 \\ s_e &= 19 \\ \hline s_v + s_e &= 154 \end{aligned}$$

Figs. 9 and 10 show the transmitter with separate exciting circuit. In fig. 9 the connection with the exciting circuit is direct. The vibrations of the exciting circuit are carefully tuned to those of the aerial wire. The capacity of the exciting circuit was 0·06 mf. The connections are so arranged that only three-fifths of the whole self-induction of the exciting circuit is also in the path of the vibrations of the aerial conductor. This arrangement was adopted because with this method of excitation an accurate comparison could be made with the method next described. For the same reason the unusual grouping of the windings of the inductance coils shown in fig. 11 was adopted.

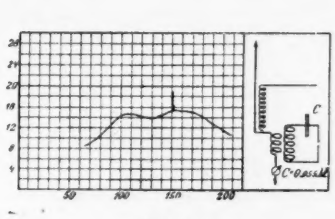


FIG. 10.

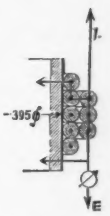


FIG. 11.

The predetermination gave two maxima of which that of the smaller wave-length had only half as great an amplitude as that of the greater. These two maxima occur in almost all the arrangements in which the excitation is produced by a separate tuned system. Both maxima were met with again in tuning with the receiver. We may remark at once that the presence of two maxima does not arise from imperfect tuning of the exciting circuit. They were detected by means of the receiving apparatus in the following way:—

The transmitter was connected as shown in fig. 9, and worked with a very low intensity (a spark length of 5 mm.). A receiving maximum was attained with

$$\begin{aligned} s_v &= 63 \\ s_e &= 17 \\ \hline s_v + s_e &= 80, \end{aligned}$$

which agrees closely with the curve. Maintaining the same intensity the receiver again worked with the following tuning:—

$$\begin{aligned} s_v &= 100 \\ s_e &= 17 \\ \hline s_v + s_e &= 117, \end{aligned}$$

and ceased to work with

$$\begin{aligned} s_v &= 200 \\ s_e &= 17 \\ \hline s_v + s_e &= 217. \end{aligned}$$

The second maximum of the receiving intensity occurred at

$$\begin{aligned} s_v &= 143 \\ s_e &= 17 \\ \hline s_v + s_e &= 160. \end{aligned}$$

With this tuning, reception was still good when the intensity of transmission corresponded to a spark length of 1 mm. The maximum obtainable intensity in this case was about 30 per cent. greater than with the simple Marconi excitation.

The aerial conductor was now thrown into vibration by being inductively coupled with an exciting circuit of the same self-induction and capacity, the arrangement being as shown in fig. 10, which also shows the curve obtained. The construction and arrangement of the coils of the aerial conductor and exciting circuit are shown in fig. 12. This form was selected in order to obtain as nearly equal conditions as possible, as regards the self-induction inserted in the various methods of excitation adopted. The experiment again gave two maxima, this time of approximately equal amplitude and lying somewhat nearer together. The reception experiment confirmed the maxima of the longer waves only, with

$$\begin{aligned} s_v &= 133 \\ s_e &= 18 \\ \hline s_v + s_e &= 151 \end{aligned}$$

The explanation of the appearance of two maxima of different wave-length, especially with the arrangement shown in fig. 15, seems to be that the vibrations of the aerial wire have two different paths according to their image in the earth, namely, either through the self-induction alone (five windings), or through the smaller self-induction (three windings), the Leyden and the spark-gap. The path through the larger self-induction alone gives the slower vibrations, the other the more rapid vibrations. The greater the difference between the two paths, and hence also the greater the difference in the time taken by the electric vibrations in traversing these paths, the farther will the two maxima be apart. For the inductive method

* Translation of article in the *Elektrotechnische Zeitschrift*, January 1st, 1903.

of excitation shown in fig. 6, a similar phenomenon also occurs in consequence of the fixed electro-magnetic coupling of the two vibration systems through the primary and secondary coils of the transformers. Our explanation of the causes which give rise to these two frequencies proves to be correct, as will be seen from the following two different methods of investigation.

Fig. 13 shows three tuning curves which were obtained with the apparatus connected as shown in fig. 9. In all three curves the vibrations of the exciting circuit were always in resonance with those of the aerial conductor, but they were produced by different amounts of capacity and self-induction.

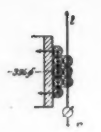


Fig. 12.

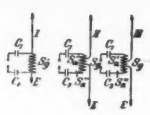


Fig. 14a.

The inductive windings were only inserted in the part common to the two systems, that is, $s_a = 0$ in fig. 9.

Curve.	Capacity.	Turns.
- - - - - - -	0·0008	14
—— · —— · ——	0·0024	9
————	0·0056	7

From this we see that the smaller the self-induction of the exciting circuit and the greater its corresponding capacity, the greater will be the amplitude of the longer wave.

The distance between the two maxima diminished simultaneously. In the limiting case where the capacity is infinite, there remains only one maximum, which has, in fact, the same wave-length as in the Marconi excitation. It is assumed, of course, that in all cases the exciting circuit is in tune with the vibrations of the transmitter.

Experiments were now made to determine whether there was any other case, except that where the capacity is infinite, in which the two maxima coincide. This is, in fact, possible. The experimental results are shown in fig. 14, and the arrangements of the

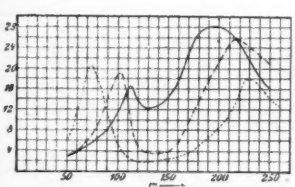


Fig. 13.

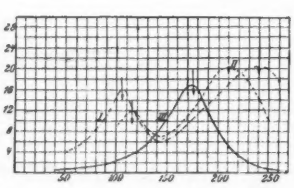


Fig. 14.

exciting circuits in fig. 14a. The latter are symmetrically arranged in this case, the self-induction and capacity, and therefore also the frequency, being kept constant. The capacity of the exciting circuit, made up of two condensers c_1 and c_2 in series, was 0·0024 (each condenser singly, 0·0048). The combination of the two jars had exactly the same capacity as the aerial wire against earth. The aerial wire and earth were now connected with various points of the inductance coils. In the case of curve I., the whole of the self-induction is included, in the other two curves only a part. In the first case the difference in the time required to traverse the two

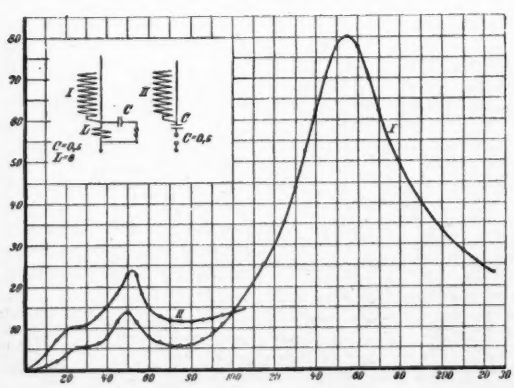


Fig. 15.

paths containing, on the one hand, capacity only, and on the other inductance only, is a maximum, and hence the distance between the measured maxima is also a maximum. In the second curve, the differences of time and the distances of the maxima are smaller, and finally, in the third curve, the self-induction of both paths is so chosen that the difference of time is exceedingly small; the curve shows only one maximum. The amplitude of this maximum is, however, not at all increased. The reason of this is easily seen. The aerial wire system is no longer connected with the coils at two points of maximum difference of amplitude (somewhat as in curve I.), but so as to include only a part of the self-induction. The aerial wire is, therefore, no longer excited by the full difference of potential. The correctness of this explanation has quite recently been verified by a different experiment, the arrangement of which is shown in figs. 15 and 16. In this, and the following figures, the capacities are not given in microfarads, but in a practical unit, the value of which is 0·002 microfarad. By means of the multiplier, the maximum of the shorter waves which occurs when the arrangement shown in fig. 9 is adopted, is determined, and then confirmed by the Marconi method of excitation, as shown in fig. 15, II., the jar capacity used in fig. 9 being directly inserted in the aerial wire circuit. In the experiments recently made, the aerial conductor used consisted of a rubber cable about 40 m. long, which was carried with a somewhat flat inclination to the top of a mast 20 m. high. The windings of the multiplier coil not in use were always short circuited. The results of the experiment are shown in fig. 15. The low maximum of the shorter waves, which in curve I. occurs at 50 m., has in curve II. a greater amplitude, but nearly the same position (52 m). Fig. 16 shows a similar

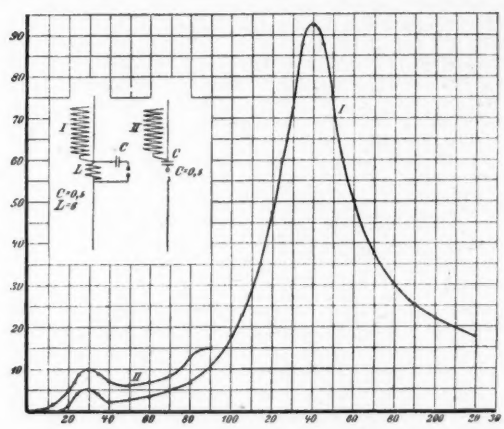


Fig. 16.

arrangement, with the difference that instead of earth a horizontal wire, congruent with the aerial wire, is used. The agreement between the low maxima of short wave length given with external excitation and with Marconi excitation is still perfect. The absolute wave lengths, when the wire is used instead of earth, are nearly always shorter than in fig. 15, apparently because the counterpoise is not electrically heavy enough, and the current crest is, therefore, not at the geometric centre of the vibration system, but is displaced slightly upwards into the aerial conductor.

(To be continued.)

TRUSTEE SECURITIES.

It has been said that investments paying over 3 per cent. interest are more or less speculative, and trustees are by law limited to what are popularly known as "gilt-edged securities." The Trustees Act of 1893 is the text-book, and under its provisions the range of what may be called legal investments is a tolerably wide one. Prior to the passing of the Act of 1889 the only authorised security was Consols, but the legislation of 1889 and 1893 opened the door to a large range of investments, and it is now a question whether there are not among electric undertakings some which might reasonably be added to the list.

Assuming that such securities as are now available to trustees are practically free from risk, it is surprising that the best of them are quoted at a considerable discount, and fluctuate extensively in market value. Consols which were worth £114 a few years ago are now quoted at about £90, the prices having ranged from 14 premium down to 10 discount.

Among the authorised trustee securities are debenture or rent-charge, or guaranteed or preference stock of any railway company in Great Britain or Ireland incorporated by special Act of Parliament, and having during each of the ten years last past before the date of investment paid a dividend at the rate of not less than 3 per cent. per annum on its ordinary stock. Under these circumstances why should not electric tramways and light railways be included in the authorised trustee securities, with similar conditions as to incorporation and dividends?

Another legal security is the nominal or inscribed stock of corporations of any municipal borough with a population exceeding 50,000, and in many such cases a large part of the money raised is employed in the construction and working of electrical undertakings, so that in this way trustees can indirectly invest in such trading business without any guarantee of their being profitable as required by the Trustee Act in the case of railway companies.

The Consolidated Stock of the London County Council is authorised, and here again the trustee is finding money for tramways, and any

other description of municipal trading—profitable or otherwise—in which the local authorities who borrow through the County Council may indulge.

Another class of securities at the command of trustees are the colonial stock registered in the United Kingdom in accordance with the provisions of the Colonial Stocks Acts 1877 and 1892. These stocks vary considerably in their market value; thus Canadian 4 per cent. are quoted at 100 to 103, New Zealand 4 per cent. at 108 to 110, Canadian 3 per cent. 100½ to 101, while New Zealand 3 per cent. are only worth 89 to 89½.

Such being the powers defined by Legislation for the guidance of trustees, it would appear that no reasonable objection can be urged against the employment of trust funds on the debentures or rent charge or guaranteed or preference stock of an electric tramway or light railway company incorporated by Act of Parliament, which has paid at least 3 per cent. per annum dividend for a stipulated period on the ordinary shares.

As an example, take the Bristol Tramways and Carriage Co., Ltd., possessing powers under several Acts of Parliament, and which has paid improving dividends for many years—thus: 6 per cent. from 1891 to 1898, 7½ per cent. in 1899, 8 per cent. in 1900, 8½ per cent. in 1901, and 9 per cent. in 1902.

The market value of the shares and debenture stock indicates the public confidence in the undertaking, but trustees have no legal authority to exercise their discretion in selecting such a security.

This is an illustration of a class of securities available in the electrical industry, as outlets for trust funds, but which are not at present included in the Acts dealing with the trustee investments.

The enormous increase in municipal indebtedness, due to trading operations, during the last few years, has created a good deal of misgiving as to the financial position of many towns, and fresh loans are accordingly placed with more or less difficulty. The most sensitive investors will naturally be found among trustees—who will not view with equanimity unlimited borrowing for speculative trading purposes—and the stock of local authorities engaged in trading operations will be closely considered in connection with the depreciation in the value of the security for the ever-increasing loans.

It would be a healthy process if the capital required for municipal purposes were subscribed locally, as the investors would be in a position to watch and control policy and expenditure, and take a more direct interest in local government than prevails under a system of borrowing from the outside.

The incident of the rates has a certain amount of influence, but not so great as would be the case if the residents had a more directly personal interest in the provision of funds and their application.

In the case of electrical undertakings, especially in small towns, the investment of local capital should be encouraged as the best means of interesting the residents in pushing the business, especially in its early career, before the advantages of the new means of obtaining light, power and traction are realised by the actual experience of a sufficiently large section of the community to exercise an influence upon the remainder.

The growth of an electric supply business, when once well established upon sound commercial lines, proceeds in a rapidly increasing ratio, particularly with the use of electric energy for power and light.

It is surprising to what a number of uses electricity is now being applied in supplying motive power at the lowest cost and the greatest convenience. In one of the Lancashire towns electric power is being used in connection with bottling machinery, dentistry, engineering, fans, hat works, hay chopping and corn grinding, hoists and lifts, laundry machinery, leather works, mattress making, mortar grinding, organ blowing, printing, refrigerating and ice making, sewing machines, weaving and woodworking—74 applications of the power, involving a supply of 457⅔ H.P. The system of hiring out the motors, which is becoming very general, disposing of the question of provision of capital for the plant in the same way as the free wiring provides for the electric light without making a demand upon the financial resources of the householder.

Electrical supply, under good business management, offers a most promising field for investment, especially when the load factor is improved by the diversity of demand created by electric tramways and light railways, and the supply of power to manufactories, in addition to the provision of the best methods of illumination.

There is no reason therefore why trust funds should not find safe and profitable outlets for investment in the new industry.

WHY ENGINEERS SHOULD ADVERTISE.*

By GEORGE H. GIBSON.

We hear much nowadays about the dignity, the honour and the glory of the engineering profession. At the same time the correspondence columns of the technical journals are filled with complaints concerning the meagre compensation usually received by engineers. These things do not harmonise. If the engineers, by virtue of their skill, ability and integrity, are indispensable in this industrial age, why are they not better paid? There are about two classes of people who can be held responsible for this state of affairs, viz., the engineers themselves and their employers, the public. Some of the blame rests upon each, but most of it upon the engineers.

In the first place, most people, including many otherwise well informed, have a very hazy notion of what an engineer is and what he does. They, perhaps, think of him as somewhere between a highly skilled mechanic, or artisan, and a professional man consulted as an expert in cases of dire necessity. They rarely regard him as a man of affairs, capable of directing and conducting large enterprises. That this is the case is shown very clearly by the attitude of state and municipal Governments toward engineers and their salaries. For instance, the wealthy state of New York advertises for engineering assistants in the office of the state engineer, offering the munificent salary of $5.00 per day for days actually worked, nothing for overtime. Bricklayers in many cities are paid $5.20 for eight hours labour and double pay for overtime. The "buyers" of department stores often receive more than $2,000 per year. Again, Kansas City, Mo., is making important and costly additions to its water supply system. In connection with this work, three consulting engineers have been retained. In spite of the fact that the advice of these men may result in the loss or the saving to the city of thousands of dollars, the Kansas City *Journal* complains that one "has been added to the city pay-roll at a salary of $1,500 a year and annointed with title of "consulting engineer," and that the services of the others "cost the city $15 every time they blink an eye;" that is, they are paid $15 per day when their services are required. No large city would think of employing legal talent at wages so small, and at the same time nearly every municipality is engaged in engineering undertakings upon which the profit or loss due to good or poor engineering judgment and skill may amount to thousands or even millions of dollars. Due to poor engineering, or the absence of any at all, hundreds of lives annually are lost from typhoid fever in some of our large cities, a loss which could be almost entirely prevented by the application of well-known engineering methods.

Now, it is plain that the only way in which public opinion in regard to these matters can be reformed is by education, and it is equally plain upon whom rests the responsibility of doing the educating. The engineers must speak for themselves. They must educate the public in engineering matters. It is as much to the interest of engineers as of lawyers or bankers to take an interest and part in public affairs and to educate and direct public opinion. The engineer should advertise the engineering profession for the good of both the profession and the public. A beginning has been made in this by engineers like Kent, Thurston and others, who have sought to bring to public attention the great revolution in the industrial and social world being brought about by the activities of the engineer. Much is also to be expected from the efforts of those, notably Mr. C. F. Scott, now president of the American Institute of Electrical Engineers, who are endeavouring to draw the national engineering societies together into a united, harmonious and powerful body. Since the above was written, Mr. Carnegie's generous offer of $1,000,000 to erect a building in New York city for the national engineering societies has placed this movement upon a substantial footing.

The timeliness and importance of such movements are manifest when we consider that 50 years hence the engineer will probably hold a position of vast power and influence in the social organism. His work touches organisation, financiering, management, and, ultimately, statesmanship. He is forced to study political economy thoroughly and at first hand. He is destined to become and is becoming the leader of vast industrial organisations and, perhaps, eventually, of the world itself. In the beginning the world was superstitious and ignorant and its rulers were priests; these were followed by soldiers who have disciplined it, and these again by lawyers, who have established the principles of civil rights. The great questions of the present and future are industrial and commercial. Science and invention should naturally, it would seem, place the source of wealth and power in the hands of the engineers, who should next hold the reins. This is not to be understood in any absolute or revolutionary sense, but it is to be noted that the professionally trained engineer is more and more becoming a man of affairs. His active life, exacting duties, accurate habits of thought, earnestness and integrity fit him to be the leader and adviser of men.

However, our exultation in the bright prospects of the engineering profession has, perhaps, caused us meanwhile to forget the individual engineer. As above pointed out, his pay is not always commensurate with his prospects, and he cannot live comfortably upon prospects in general and nothing in particular. His practice of "the art of directing the great sources of power in nature for the use and convenience of man" is not always supplemented by the art of being well paid for that practice. It would seem that there should be no great difficulty in selling at a good price services so profitable to the purchaser as those of the engineer, but it appears that he usually fails to do it.

Careful consideration of the subject seems to indicate that the limited financial success of many technical men arises more from lack of business perspective and enterprise than from anything else. First, they do not advertise enough. It is one of the first duties of every man to let the world know what he is good for. Honest advertising pays both parties concerned. If you can do a thing better than it is generally done, you should tell about it. It may help some one else, but it will probably help you most; besides, you don't need to give the whole secret away. In other words, engineers should write articles for the technical press based upon their work, study or observation. Such articles are valuable to refer to when applying for positions or soliciting work. They form the cheapest form of personal advertising, since they are usually productive of revenue. Most technical papers will gladly publish and pay for articles of any merit. "Men are known for their ideas, and an idea properly disseminated has more advertising value than

* Reprinted from the *Michigan Technic*, 1903.

a vast amount of money. A man of real enterprise, however, will not stop with technical press, but at opportune time will discuss in the public press engineering and economic subjects of popular interest, such as the purification of public water supplies, public transportation, the fuel situation, gas and electric lighting, and many others of equal importance.

HULL MUNICIPAL TELEPHONE SCHEME.

(*Concluded from page* 373.)

At the resumption of the inquiry on Friday, August 28th, the Inspector asked what was the present position of the telephone service, and what were the relative advantages to the Corporation, and what safeguard would the ratepayers have?

The Town Clerk said that when he came to deal with the matter in his address, he should show that this question was not within the province of the Local Government Board.

The Inspector then asked that, supposing the Corporation decided not to go on, or supposing the Local Government Board decided there was not sufficient ground to give their sanction for a loan, what would the position be?

Mr. Laverack replied that the National Telephone Co would remain in sole control.

The Inspector asked if the competition would entirely cease, and the Town Clerk said that not only would the Corporation have no right to interfere, but the Post Office would be placed in a similar position.

The Inspector pointed out that the real point was the advantage or disadvantage the system would be to the ratepayers. If more than half the ratepayers thought it was a disadvantage or that it was an advantage, and on the other hand, the opinions of those who were best qualified to judge clearly showed that the advantage would be in the other direction, the duty of the Local Government Board would be to give their decision in that direction.

Mr. Dixon, managing director and chairman of Blundell, Spence and Co., Ltd., said that his company employed between 350 and 400 persons. Their rateable value at present was £880 per annum, but he thought it only fair to state that they had just been assessed at £1,700—practically double.

Mr. Robb: Have your firm been subscribers to the National Telephone Co. since 1892?—Yes, and we have nine instruments installed.

Are you satisfied with the service you receive?—Yes, we consider it an efficient one.

By the Inspector: The existing service gave satisfaction to a large majority of the subscribers.

The Inspector: Can you really answer for the present subscribers?—Largely. I believe they are satisfied with the present system.

Mr. Robb: Can you tell the Inspector anything about the additional facilities that have recently been offered by the Telephone Co. in the event of the Corporation not proceeding to compete?—Yes.

The Inspector: That is the point I want.

Witness: Naturally the National Telephone Co. have been making considerable efforts to meet the public requirements, and one very important change they suggest is not to provide the party wire system, but a duplicate on a very large and successful scale. At the present time anybody could have an unlimited service on the National Telephone system for £5 per annum.

The Town Clerk: On the party line system.

Witness said that service was most efficient, and he knew that many persons who were using it were perfectly satisfied. Especially did it meet the requirements of the small user. It certainly was what was known as the party line system, but facilities had been provided for calling up without interrupting other messages.

Mr. Robb: Your view is that any person requiring an unlimited service can now secure it for £5?—Yes.

Whereas the Corporation rate will be six guineas?—That is so, and the difference between the two services would be very slight.

Speaking on behalf of your firm, would you be prepared if the Corporation system were proceeded with to take out your National Telephone instruments and instal those of the Corporation?—No; we should not give up a system that was affording us every facility and satisfaction for the purpose of experimenting with a new one for the sake of a possible saving of a few pounds per year.

Is it your opinion that what you would gain as telephone users you would lose as ratepayers?—That is precisely the position.

Asked again as to what he thought about the Corporation scheme, witness characterised it as being rotten. It was an enormous risk to lay down so much money without first obtaining at least 1,000 engagements. Mere promises to take instruments were not, he thought, by any means sufficient.

Cross-examined by the Town Clerk, witness said that he did not believe the Corporation would obtain 300 promises to use their telephones.

Mr. T. H. Sissons, J.P., said that the ratable value of the premises of Sissons Bros, Ltd., was £1,700. He expressed the opinion that there was no public demand for the municipal telephone. There might be a loss on the scheme, because the Post Office could take it over in 1911. The revenue, of course, then ceased, and he very much doubted if the Post Office would offer the Corporation the price of old metal for it.

Mr. James Stuart, J.P., a director of the British Oil and Cake Mill Co., which had a rateable value of £9,000, said there was not a sufficient demand to justify the great risk the Corporation intended to incur. No business man would dream of putting his money into an undertaking of that kind, saddled as it was with an onerous condition of time.

The Town Clerk: Do you know that this very difficulty was fully considered by the Select Committee in 1898?—No, I don't know.

Do you know that they suggested a method to meet it, which the Government have adopted?—No.

The Inspector: I think you can leave it to argument.

The Town Clerk: Very well. I will deal with it when I come to address you.

Mr. A. E. Ballan, district goods manager in Hull for the North-Eastern Railway, said that he had instructions from the general manager of the company at York to represent that company at the inquiry. The company owned practically the whole of the docks in Hull, with the exception of the Alexandra Dock, and the rateable value in Hull was £160,000, which was one-seventh of the whole rateable value. His company's opinion was that there were always experiments being made in telephony, that the property must depreciate very considerably, and that the scheme would involve a loss on the rates. The company were very strongly opposed to it. They had not taken a party view at all. They simply looked to the ratepayers' view. Anything that led to the prosperity of Hull must benefit the North-Eastern Railway, and if the telephone question would benefit Hull the company would probably support it.

Mr. E. F. Ingleby said that he represented an aggregate rateable value of about £1,400. He agreed entirely with what the witnesses for the opposition had said, his strong point being with regard to 1911.

Mr. E. T. Sharp, J.P., and Mr. T. R. Smith, draper, also gave evidence on similar lines to the other witnesses against the proposal.

Mr. H. Laws Webb, the principal expert witness for the opposition, was then called. He had inspected the system at Hull, and he thought it was an important matter for a consulting engineer to make himself acquainted with the position of the rival competitor. Mr. Bennett's scheme was not an adequate one, because it did not provide sufficiently for a large development. The attention of the Corporation Committee had not been drawn to the extensions which would necessitate in a very few years a very large expenditure of capital. The points in a competing system where a large development that would arise from the low rates, as proposed in Hull, and the large outlay rendered necessary thereby. The capital outlay that would inevitably result in the course of the next three or four years was from £160,000 to £200,000. That was below 10 per cent. Five per cent. of the population would mean 12,500 stations, and an expenditure of £350,000. The outlay of £160,000 to £200,000 was based on an estimate of rather less than 3 per cent. It would mean 5,000 or 6,000 stations. Three per cent. of the population would mean 7,500 stations, which, of course, would not be covered by a capital of £200,000. It was always necessary to carry a great deal of spare plant. Active competition he took into account, because it always led to a large development. The position in which the Corporation undertaking (if it was started as proposed) would in a short time be a poor one in face of the present system of the National Telephone Co., which had 3,200 stations. The proposed scheme, on the other hand, was for a maximum of 2,000 stations. The Corporation were taking the position of the under dog in the fight—(laughter)—when they ought to be the larger dog. His experience was that the ultimate result must be the survival of the larger system in the case of two competing lines. The estimate of Mr. Bennett assumed a definite restricted expenditure of £43,000 odd. In a telephone business it was, of course, possible to limit the capital expenditure in that way, but it gave a delusive idea of the telephone business. It gave the idea that a system could be got for a definite sum, whereas it was always growing, and this must be provided for. An important feature of the telephone business was that the capital account could never be closed. The telephone system must grow to live. He did not think that it was possible to run the 2,070 completed stations, as proposed in Hull, without adding to the capital. The witness was then taken in detail through Mr. Bennett's scheme. He said that the 12 per cent. of the total capital expenditure which Mr. Bennett took for "spares" was contrary to all experience. The scheme made a proportion of 88 per cent. for plant in active use, and 12 on spare lines, whereas the usual proportion was 60 to 40. In London the Postmaster-General had 30 per cent. on active and 70 on surplus at the present time, and the original proportion would have been greater—about 90 per cent. for surplus and from 5 to 10 on active service. That was the proper way to set out upon a telephone undertaking, broadly speaking. The effect of starting with a restricted scheme was that more money would have to be expended before the promoters expected it, and that a great waste of money would be incurred, the subsequent cost being greater than it would have been at the outset. The Corporation would not be well advised to embark upon the scheme. It was not a generous estimate. The principal reason for surplus plant was in order to give a good service. They must be in the position to connect up subscribers as quickly as they could. It was generally the case that, when a man made up his mind to have a telephone service, he wanted it immediately, and a good engineer would provide for this, which involved the carrying of a large amount of spare plant. This feature had been, it was true, recognised in the reports of the Corporation Committee, but it was always disguised, and the expenditure worked out at so much for lines in use and so much for spare lines. But the latter could not be considered as future requirements, as Mr. Bennett stated. They were present requirements, and the surplus plant should be provided for in the first expenditure of capital, and this must be reckoned in the cost per line at the start. The specification of the Corporation provided the "Bennett

Ring-through" system, and he thought this was an altogether inferior kind of service. The whole object of a telephone system was to make and unmake communications as rapidly as possible, with as little waste of time as possible in the operation of each communication. This, of course, affected every user, and especially the more frequent users, and a little waste of time in each connection meant a large waste in the aggregate. The standard system to-day was the "relay," or common battery system, in which the working was practically automatic. The cables of Mr. Bennett did not meet the requirements, and he thought his specification of cables a most unwise one. He stipulated 84 different sizes of cables, which was a great departure from standard practice, and would necessarily offer great inconvenience. It was a phenomenal kind of specification. If it was intended to lay out a system which was never intended to grow, Mr. Bennett's system might be adopted.

What is the object of this extraordinary kind of specification?—It is to get cheapness in first cost.

An imprudent method has been adopted in order to get cheapness in first cost, and it would prove more expensive in the long run?—Yes; it is laying down an inflexible system, which pre-supposes subscribers in certain spots, and it would be very difficult to extend rapidly and economically.

What would be the inevitable result of the system?—I should say, briefly, waste. It is sure to give a lot of dead wires, and will lead to great inconvenience by reason of these small distributing cables, that are practically fixtures. They will become useless or have to be replaced or reinforced by additional cables all the way back from the distributing point to the exchange.

The proper system, witness said, was to lay larger cables, and to distribute from joint boxes, which gave a flexible system of connecting and disconnecting cables of different sizes.

The Inspector: Haven't we got joints in this system?—Yes, permanent joints, which are inflexible.

The Inspector: Oh! I see your objection now. They are all permanent.

In further evidence witness said that he thought the ordinary business community was better served by a superior service if the rates were fair than by an inferior service at cheaper rates. He proceeded to refute the argument that competition was necessary for telephone development, and in support of his statement he quoted the instance of New York, where the telephone had developed into the largest system in the world without any competition. It had been developed entirely on the message rate system, and he thought that showed that with an efficient service, which was satisfactory to the community, they could meet every development without competition. It was not a fundamental theory that there must be competition to have development.

Mr. Robb: It has been claimed by the Corporation that they were catering for the masses instead of for the select few. Will their proposed rates cater for them better than the National Telephone Co.'s party-line service?—I don't think there is very much to choose between them.

The party-line system was a very legitimate and proper method, and was very successfully used in a great many places. It was a legitimate way to reduce the rate.

Mr. Robb next dealt with the working expenses in the estimate of Mr. Bennett. Witness thought that the expenses estimated there, according to the standard of telephone service he (witness) recommended, were very much under-estimated. If they were going to have an efficient service there would be needed a very much more organised, better paid, and trained staff than Mr. Bennett estimated for. On this alone he estimated the expenditure as £5,500—£3,000 more than Mr. Bennett put it. As to the depreciation of 2½ per cent. allowed by Mr. Bennett, the general practice was to allow from 5 to 7½ per cent. He would advise the Corporation to allow 5 per cent. Taking into consideration the general position of the municipal telephone, he would not advise the municipality to undertake a service in Hull. He did not agree with the opinion that the Government had imposed this matter upon the municipalities. The carrying out of the scheme as proposed would involve a loss on the rates.

The Town Clerk then cross-examined the witness.

Your experience has been in America?—I could hardly say that. I have visited the Continent, inspected the systems there, while I have spent a fair proportion of my time in England.

You are more conversant with the New York system than any other?—Yes, certainly.

When giving time and figures, have you given them on the basis of New York wages?—I have taken the English way. I am quite aware of the English price.

Your main objection is that the scheme is not sufficiently extensive?—I don't think that is the point I made. My report of the scheme is that, as a whole, the expenditure of the Corporation is not sufficient, owing to the absolute necessity for expansion.

That will depend entirely on what will happen?—Yes.

As to which none of us can be certain?—No.

Don't you think it shows a little caution, cutting down our expenditure to what we should consider was the lowest possible amount having regard to the place?—I can only say that if you cut it down it is not worth doing. If you are going to cut it down to a thousand or two thousand subscribers it is not worth doing.

An exchange of 2,000 subscribers would not be worth doing?—No, not for you.

If your theory be wrong with regard to this large development in the future, then of course you are mistaken? Then, of course, you go back to the other alternative?—It is not worth doing.

You think there will be a very large development?—Yes; I think there will be a large development.

Then we have got a very good thing?—You will have to develop at a loss.

Presumably you would not work it at a profit?—I don't presume you will work it at a profit.

The objection is, we ought not to introduce a system of municipal telephones into Hull?—I don't make that objection.

You don't agree with it?—I don't know.

Mr. Robb: The gentleman is called as an expert, sir.

Mr. Webb: I don't think it is a desirable thing in Hull.

On proper lines you would say yes?—If you had it on proper lines. I have no objection to municipal telephones.

In view of the statement you made that we shall be faced with an expenditure of about £160,000 in a few years, do you think we shall have to get it up on an obsolete system?—Yes, even on an obsolete system. That has been shown at Glasgow—(laughter).

You think the larger system must always prevail?—Yes, in the long run.

That would be the unfortunate position of the National system in Glasgow?—No. I think the facts are the other way about.

The Town Clerk then gave some figures to show that the municipal system had the larger number of stations, but Mr. Webb said that they could not judge from a directory.

You think that, with a scheme like this, there would be no more cost than if we put in a larger scheme?—Yes: it is not a mere question of addition to the system.

Don't you think we could add to our plant as required?—You can't work a telephone business by ordinary rules of business. It is not a question of laying in a stock of materials.

Do you think it is a wise thing to burden the scheme with a large amount of capital at the outset?—I don't think it is a wise thing. It is necessary.

Have you ever laid out a telephone system from the beginning?—No; but I am quite competent to do so.

You said that to work this proposal on the 12 per cent. spares is inadequate?—To furnish a system of this size and work it with this margin is impracticable.

With regard to the switchboard, I take it it is a question of difference between engineers with regard to the merits of the central battery system?—I believe not.

Did Mr. Sinclair say it was a passing craze?—No; I don't think he did say that.

He was chief engineer to the National Telephone Co. was he not?—Yes.

Is it because he has put it in that he dislikes it?—I don't know that he dislikes it. I am surprised to hear that statement.

At any rate Mr. Bennett does not approve of it?—Yes, I gather from what he says that he does not.

Are you aware that the chief engineer of Stockholm will have nothing to do with it?—I am not sure.

You think this is to be an inflexible system?—Yes, that is the way it appears to me.

If a cable be found to be too small, is there any difficulty in drawing it out and substituting a larger one between Saturday night and Monday?—There is no difficulty.

That is flexible enough is it not?—Oh, yes, flexible enough if you put it that way. You can pull a whole system down in the same way.

In Glasgow they have increased their subscribers by the same system by 3,000 within a year?—I think you will find that the larger amount of it was laid down in the beginning. You will have just the same trouble in the long run.

The Town Clerk: I am told not by the engineer who laid it out.

With regard to working expenses, Mr. Bennett's estimate is based on actual results in other places. Do you know that?—No.

Can you give any results in other places?—No, I give you the general practice in other places.

Have you ever managed a system?—I have never been the sole manager.

Your basis is imaginary, then?—No.

Have you based your figures on the results at the Post Office?—No, I have not. I have based it on the general way of carrying out such work.

With regard to depreciation, you differ with regard to our figures?—Yes.

Have you any regard to the question of the sinking fund?—I have taken depreciation as a thing entirely apart from sinking fund.

The depreciation fund is really a reserve fund?—Well, practically I agree with you.

The witness admitted that telephone companies had neither depreciation nor sinking funds.

With regard to connection, I believe you mean it is important that the connection should be almost while you wait?—That is what the customer expects.

Do you expect we shall be at a loss in that respect?—Necessarily you will if you don't have a large margin.

Don't you know that in Hull they have to wait four or five or six months for a connection?—I don't know that, but I know the proper standard is to connect up within a few days.

Mr. Dixon having cross-examined Mr. Webb, Mr. Robb said he thought that the witness had not been shaken by the cross-examination, and therefore he would not re-examine him.

Mr. Kingsbury was the last witness called by Mr. Robb. In reply to the opposing solicitor, he said he regarded Mr. Bennett's estimate as so arranged that it did not provide for expansion or development. They must consider what the developments were likely to be and they must anticipate. It was cheaper to do that than to pull up the streets later on. He considered the provision for surplus plant was hopelessly inadequate on the assumption that it was to be a permanent system. If the system were only a temporary one, then he would regard the estimate as a correct one. The central battery system was the general one, and he did not think that in a city as large as Hull the "ring-through" system would be a success. He would put depreciation at a little higher estimate

than Mr. Webb. He had no hesitation in saying that the introduction of a municipal system was most undesirable. From the point of view of the telephone subscriber in Hull, the existence of two systems was very disadvantageous. From the point of view of cost, a double telephone system would be more expensive than one. He believed this scheme would involve a loss on the rates, as the tenure was a most vital question. He did not think that, if the loan were granted, the system would be installed in less than a year.

Cross-examined by the Town Clerk: You object to competition?—I do, emphatically.

You think the policy of the Government with regard to competition is wrong?—Yes. I am sorry to disagree with Parliament, though Parliament does not advise competition.

Are you sure?—I think so.

They say it is necessary?—The Postmaster-General does not. I have studied the matter from a very careful point of view, better than any member of Parliament. I give you the benefit of that view.

You are interested in preventing opposition to the National Telephone Co.?—Not at all.

Mr. Dixon having cross-examined the witness, the proceedings were adjourned until Saturday.

On Saturday, August 29th, Mr. Robb proceeded to address the Inspector on behalf of the opposition. The inquiry, he said, was important to the telephone users, but most of all it was important to the ratepayers. The telephone was not comparable with the undertakings which were generally entered into by municipal Corporations. It was a class business, and not a general business; therefore, if it was a financial failure, the many would have to be taxed for the benefit of the few. He had had the cream of the mercantile community before him protesting against the scheme, and doing so because their opinion was that it would not be a benefit to the community, but would entail a loss upon the rates. The principal feature of their objections was, they had distrust as to what the scheme was going to lead them into. They thought the estimate was an impossibly low one, and that it was being put forward as a bait to the Council to lead them into a capital expenditure which they never contemplated. Mr. Bennett's estimate was very misleading, in that it gave the Telephone Committee and the Corporation no adequate conception at all of the ultimate capital expenditure into which they must inevitably be drawn in the near future. They were told it was a mere trifle of £40,000. So it was at the start, but it would soon grow and involve a much larger expenditure. The Tunbridge Wells estimate in 1899 was £7,000, but in 1902 the expenditure was nearly £30,000. At Glasgow the estimate was £97,000, but the actual expenditure up to date was £270,000. That was an example of how money was scooped into enterprises of that kind. Once they were committed to the scheme, they must go on. Mr. Webb had put the capital expenditure in a few years' time at £150,000 or £200,000, but he thought it might be more than that. He was bound to say he felt that the opposition, in spite of the Inspector's courtesy and fairness, were placed to some extent at a disadvantage, because naturally when a scheme was brought forward by a local authority the Local Government Board, unless the contrary was shown, imagined it was put forward with the approval of the citizens, and that it was a scheme which would benefit the community. His clients said that in its nature it was an Imperial business and not a local business—it was a class business and not a general business; and although it was true that the Legislature, by the Act of 1899, had contemplated competition, it was clear that since then the policy of the Government had altogether changed. The Postmaster-General on June 8th last said, as a result of his experience, that that was not a suitable matter for competition; and he further said that after 1911 he could not contemplate any Postmaster-General renewing a license or allowing the business to pass out of his hands again. They had been told that the Act of 1899 urged and imposed competition upon municipalities, but it did nothing of the kind. It was true the Select Committee of 1898 recommended competition, but the Act did not in terms directly authorise competition. It authorised it merely by implication. It said that where the Postmaster-General had granted a license the local authority "may" raise the money that was necessary. A further point he would urge was that although the Legislature authorised municipalities to enter into that kind of business, it was the duty of the Local Government Board to inquire into the local circumstance, and to ascertain if the scheme would meet any public want, or whether it was merely duplicating an existing system that was efficient, and whether the state of the local finances justified what the Postmaster-General had referred to as an experiment, and, further, whether it was the general wish of the majority of the ratepayers that the system should be established. He said emphatically that the scheme, with the opposition of gentlemen representing all the highest and best interests in the city, started handicapped to such an extent that it must end in financial disaster. The National Telephone Co. had spent a considerable sum of money upon the improvement of their system, and the result was it was thoroughly efficient and met all the public requirements. The opposition further said that the scheme was financially and technically unsound, inefficient, and incomplete, and that to instal a system on the inadequate and cheeseparing lines proposed, and with an obsolete plant in opposition to one that was efficient and determined, was merely to court disaster. Tunbridge Wells was an example of a municipality entering upon a business which it did not understand, and entering into it upon inadequate and delusive estimates. Mr. Robb went on to condemn the "ring-through" system which the Corporation propose to adopt, as being old and obsolete; and remarked that he did not hesitate to say that one of these days the Corporation of Glasgow, who had adopted it, would wake up to the fact that instead of an efficient system they had a museum of telephonic antiquities and curiosities. As to whether Mr. Bennett had made adequate provision for the expansion and development of the system in Hull, he said that the fundamental fallacy underlying all his estimates was that he could afford to ignore the proper and adequate provision of surplus plant; that he could frame his system in such a cheeseparing and restricted manner as to get the minimum of cost and the maximum of revenues at the outset. What business man starting a new business would expect 88 per cent. of his capital outlay to be worked at a profit on the initial day? The expert evidence had proved that the cost would be the same as in Glasgow. It was of little consequence whether they could equip their system in six or twelve months. What position would they be in at 1911? They had been told they could get an extension of the license. Why had they not done so? It was well known that the period of the tenure was a strong point in the opposition for a considerable time, and yet no step had been made to get the license extended. They knew that, in view of his announcement, the Postmaster-General would not allow the telephone system to go out of his hands at the end of that period. To the business man that was a perfectly mad business. A great deal of stress had been laid on this point of limited tenure. What would be the position of the ratepayers deprived of their business at the end of 1911 with these instalments of interest to pay in 14 years, and the capital of the loan as well. It had been claimed by the opposition "We carry the Post Office with us." Mr. Bennett carried a great deal with him. He gave the National Co. their experience. Mr. Bennett was an Atlas carrying the world on his shoulders. He put it as a business proposition: would any business man combine with his own any system that was not uniform with his own? His simple point, therefore, was on the score of probability, and, having two alternative systems to select from in 1911, the Postmaster-General would in all probability take the suitable one—the one uniform with his own system—rather than the other. Regarding the letter of February 9th, 1903, sent by the Postmaster-General, he said if ever in his life he had seen a letter that was so absolutely guarded and non-committal in its terms, it was that letter, and to say, that it or the terms of the license or the specification committed the Postmaster-General to any approbation of the Corporation system of working, was to strain the words beyond their reasonable and fair construction. He next dealt with inter-communication, and said he would agree with the proposers that this was the lesser evil. But it did not alter the position of his clients as ratepayers one iota. They were opposing this scheme on its general financial bearing, because it had the hazard of speculation. Mr. Bennett himself did not regard inter-communication as safe. He seemed to regard inter-communication as safe only to the larger. The Corporation were going into this scheme in the smaller way. Continuing, he said there was no public call or demand for the municipal system. Half the ratepayers, or rather the large majority of the ratepayers, were absolutely opposed to it. The existing system fulfilled every reasonable requirement of the public for telephonic facilities. What he wanted to impress upon the Inspector was that this was a ratepayers' question. The security of the ratepayers was being pledged for the benefit of the few. The real test of this scheme was whether it was commercial or not. Anyone would be pleased to take up and finance the municipal enterprises, such as the trams or water or gas—for they were all profitable concerns. But from what they had heard from Mr. Ingleby and Mr. Arthur Wilson it was seen that this scheme was regarded by commercial men as unsound, and it would be impossible to float it as a private company, or attract a single penny of private capital to it. Should the ratepayers of this city, he asked, be committed to an experiment which was regarded in that light by commercial men? Should they be saddled with the risk, should they be held down by the onus of a system which would not attract as a private company a single penny of private capital? Mr. Robb concluded by drawing a parallel between the proposal and the recent Blue Book published regarding the war. The Corporation of this city, he said, were contemplating a telephonic war. They were going into war with the Telephone Co. The great complaint against the war in the Blue Book was that the Boer war was entered into without making adequate provision. The Corporation were going into this telephonic war without making adequate provision for the present or future, without knowing anything regarding the enemy's position. Mr. Bennett was leading his army of 2,070 instruments against the enemy's army of 3,020. He was leading his army into the field with old muzzle-loading carbines against the repeating weapons of the enemy. This scheme was not taken up by the desire of the ratepayers. He concluded by thanking the chairman for his patient hearing of his (Mr. Robb's) case.

Dr. Jackson said that they were there as ratepayers, and from the point of view of the ratepayers he had no hesitation in saying that the proposed scheme was fraught with danger. How could it possibly pay its way and not form a charge on the rates at the end of 1911?

The Town Clerk replied for the Corporation. He said that he certainly thought with Mr. Robb that the Inspector had given a very patient hearing to both sides. He submitted that the persons who had to decide whether the municipal telephonic system should or should not be entered into were the Corporation of Hull, as representing the ratepayers of the city. The Act of Parliament—presuming there was a loss—said, "If there be a loss, it shall be chargeable upon the rates, and you shall not borrow for it."

The Inspector: If the Local Government Board form the opinion that this scheme is likely to result in a loss involving a permanent charge upon the ratepayers in the future, they will not give their sanction to it.

The Town Clerk said that the evidence of the opposition contained a good deal of inconsistency. According to the opposition, there was going to be no demand whatever for a municipal tele-

phonic service. But, strange to say, when they studied the evidence of the opposition experts, they found that the great ground for objection was that the Corporation were suggesting entering upon a system which would expand largely, and that no provision was being made for the expansion. That struck him as being exceedingly funny. The opposition, however, said that it would cost them a great deal more if they kept extending later on, and that it would be by far the better way to make full provision at the outset. But would it? The Corporation preferred to work on safe lines, and to secure the extra customers ere making extra provision. Comparing the evidence of the experts on both sides, he said that the Corporation had in Mr. Bennett and Major-General Webber two of the country's best experts—men who gave their evidence on actual experience, whereas the opposition experts based their evidence on assumption. If the system were purchased in 1911 they might very safely assume that they would receive at least their £26,000, which, together with the sinking fund, &c., would make up the £44,000. Reference was made to the agreement between the National Telephone Co. and the Corporation regarding the wayleaves of the company.

Mr. Dixon (representing the Hull and District Chamber of Trades) said that the Corporation had the voice of the people behind them.

The Inspector said that he believed the Local Government Board would have no difficulty in coming to a decision.

THE BOARD OF TRADE ON NURSING.

Recently the Board of Trade sent to all electric traction undertakings a letter containing several pointed suggestions* for the safer operation of the cars. With the bulk we are in fair agreement, although we do not think a folding step either practicable, desirable, or necessary, at the present time; nor can we acknowledge that a properly constructed reversed stairway is to be condemned as dangerous because it obstructs the motorman's view on the pavement side. When there is any obstruction it occurs only to a very limited extent.

However, if there is a staircase made which is as safe to the passenger, and requires no more platform room than the reversed stairs, while it permits the motorman to obtain a clear field of vision through 180° on either side of his front, then that staircase is evidently more desirable than the other. If the reversed staircase goes, the motormen who are accustomed to it will bemoan its loss for it is a partial and not-to-be-despised shelter in rough weather.

There are two sentences in the suggestions to which we do object. One states that for a conductor to have to "nurse" the trolley-pole is an admission of defective adjustment of the overhead work. The Board of Trade object, that is to say, to the trolley rope being held by the conductor.

How many managers and engineers will be found to endorse such an objection? If ever a rule was required it is the rule that enforces on conductors the importance of "nursing" the trolley through junctions and overhead complications of any kind. It is improbable that the Board of Trade would say that to take a car through facing points at four miles per hour is to admit defective adjustment of the special work; but that is practically on all fours with their present remark. An overhead switch or frog may be adjusted to perfection in the morning and cars may run under it at 10 miles per hour without de-wiring, but no tramway man of any experience will bet a bad halfpenny that some time during the afternoon a car travelling at the regulation speed will not have the pole off at the very frog, and with disastrous results probably, unless the conductor is doing what the Board of Trade contemptuously term "nursing" the pole. An overhead switch is a much more delicate piece of apparatus than a rail point, and is relatively more liable to be put on the sick list; a liability which will disappear by no means, be the inspection ever so conscientious and frequent.

That very many accidents to overhead work are caused by trolleys de-wiring at badly-adjusted special work goes without saying, just as there are many to be put down to trolley wheels, heads, poles, springs, or standards, which are slightly or seriously injured; or, again, many to the over-careless driving of the motorman. Indeed, the very recital of some of the causes besides that "defective adjustment of overhead work" should be sufficient to frighten any manager who has overlooked it hitherto, into issuing immediate instructions to conductors to nurse their poles assiduously ever after.

The other point to which we object is the implied endorsement of the practice of insulating the trolley-boom from the socket, which is observed in some undertakings, with what object we have never been able to elicit with any kind of clearness.

It is evident that with a pole insulated from the standard, and the standard connected to earth through earth lamps, or an equivalent warning device, if the insulation between the trolley-head and the pole breaks down from any cause, the potential of the pole rises immediately, but the earth lamps or indicators are not brought into operation, with the result that top-deck passengers run a certain risk of getting shocks, unless, indeed, the whole trolley boom is swathed in absurd wrappings of insulating tape at anything from 1s. 6d. to 4s. 6d. per lb.

We thought, until now, that the Board of Trade intended a warning to be given immediately the trolley standard, *or the pole*, became alive, but the impression seems to be inaccurate, in the light of the paragraph mentioned above.

With the recommendation to minimise the risk of accidents by reducing the number of overhead "traps" to the utmost, we agree heartily, and we hope to see it followed up by the removal of the hundreds of **V** anchorages that still survive on the older roads. We trust that no road built during the last two years has anything of the kind to disfigure it and to increase the maintenance charges.

Finally, we welcome most cordially the Board of Trade letter, as a sign that the Railway Department is going to put a little more energy into its tramway work, and we hope that we shall have the honour to criticise such advisory documents more often in the future than in the past.

* See p. 373, Electrical Review, September 4th, 1903.

SOUTH AFRICAN NOTES.

(From our Johannesburg Correspondent.)

Johannesburg, *August 17th*, 1903.

Potchefstroom.—The Government has invited tenders for the installation of plant for the electric lighting of Potchefstroom, applications to be received up to the end of October. The Health Board considers this a serious and unnecessary delay, "like all Government work," one member remarking that the private company would be supplying two-thirds of the town by then. The installation of the Potchefstroom Consumers E.L. & P. Co. is now completed, and Mr. Skirving, the resident magistrate, will perform the ceremony of switching on the lights in a few days.

Bloemfontein (O.R.C.).—The Public Works Committee reported in favour of a system of tramways for the town. As to whether a concession should be granted or the tramways should be controlled by the Council was an open question, and it was decided to appoint a commission to visit the coast towns to ascertain how the systems were worked there, a sum of £200 being devoted for the purpose.

Newcastle (Natal).—The installation of the electric light at Newcastle is expected to be finished shortly. The work is being carried out by private enterprise, as are many other schemes now on hand in South Africa. The concession was originally granted to Mr. P. Herd, who later ceded his rights to the Newcastle E.L. & P. Co.; it runs for 11 years. At the expiration of the concession the Corporation has the right to expropriate, acquiring the whole at valuation, the life of the plant being estimated at 40 years. The plant consists of two multitubular boilers generating steam at 120 lbs. per sq in., and generating plant consisting of two horizontal single cylinder engines, driving two 40-kw. compound-wound four-pole dynamos. The company have 700 lights already wired, and provision is made for plant to double the present capacity. Private consumers will pay 1s. per unit for the luxury, and for municipal purposes the charge will be 4d.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

18,234. "Improvements in fuse blocks." J. Sachs. August 24th.

18,250. "Improvements in thermal cut-outs." E. A. Carolan. (The General Electric Co., United States.) August 24th.

18,251. "Improvements in processes of insulating coils." E. A. Carolan. (The General Electric Co., United States.) August 24th.

18,253. "Improvements in magnetic controlling devices." E. A. Carolan. (The General Electric Co., United States.) August 24th.

18,254. "Improvements in a combined socket-shell and shade-holders for incandescent electric lamps." E. A. Carolan. (The General Electric Co., United States.) August 24th.

18,256. "Improvements in time-limit controllers for circuit-breakers." E. A. Carolan. (The General Electric Co., United States.) August 24th.

18,257. "Improvements in electric switches." E. A. Carolan. (The General Electric Co., United States.) August 24th.

18,304. "A water-wheel for the generation of power for electricity or other purposes." A. Phillips. August 25th.

18,318. "An improved electric incandescent lamp." G. Wallace. August 25th.

18,319. "Improvements in electric battery jars." A. F. Lloyd. August 25th.

18,323. "Improvements in machine for making battery grids." T. J. Coster and Smith Storage Battery Co. August 25th. (Complete.)

18,334. "The electrical treatment of milk for the separation of cream." H. Hunt, S. Aston, M. Rose, and J. G. Howard. August 25th.

18,336. "Improvements in electrical interrupting devices for currents, particularly those of high intensity." T. J. Murphy. August 25th.

18,343. "Improvements in electric vapour lamps." E. A. Carolan. (The General Electric Co., United States.) August 25th.

18,344. "Improvements in electric lamps." E. A. Carolan. (The General Electric Co., United States.) August 25th.

18,354. "Improvements relating to electro-magnetic rail brakes." C. A. Wilde. August 25th.

18,376. "An improved connection block for electric conductors, applicable also as an insertion contact and ceiling rosette." W. P. Thompson. (The firm of O. and H. Keller, Germany.) August 25th. (Complete).

18,383. "Improvements in trolley pulleys for electric tramcars or railways to facilitate the finding of the trolley wire." W. Rhodes. August 26th.

18,390. "Improvements in the construction of electric insulators." A. E. Mitton, R. Whitehouse, and E. Blakemore. August 26th.

18,393. "Improvements in electrical ndicating instruments." A. B. Carver. August 26th.

18,398. "Improvements in and relating to automatic electric signalling." H. Hawthorn. August 26th.

18,411. "Improvements in or relating to the steps of electric tramcars and like vehicles." J. F. Mason. August 26th.

18,453. "Improvements in dynamo-electric machines." C. Macku. August 27th. (Complete.)

18,485. "Improvements in secondary or storage batteries." H. Wade. (H. Rodman, United States.) August 27th. (Complete.)

18,536. "Improved means and apparatus for controlling electric motors." O. Imbay. (Bullock Electric Manufacturing Co., United States.) August 27th.

18,550. "An improved construction of commutator for dynamos and electric motors." J. Maclean. August 28th.

18,555. "Improved section insulator for overhead wire systems of electric traction." J. H. Luby, W. Harris, and J. J. Ballard. August 28th.

18,556. "Improved adjustable crossing for overhead wire systems of electric traction." J. H. Luby, W. Harris, and J. J. Ballard. August 28th.

18,557. "Improvements in and relating to points for overhead wire systems of electric traction." J. H. Luby, W. Harris, and J. J. Ballard. August 28th.

18,558. "Improved clip for clamping or binding the wires to fittings in overhead wire systems of electric traction." J. H. Luby, W. Harris, and J. J. Ballard. August 28th.

18,581. "Improvements in a system for electric lighting of railway trains." H. Leitner and R. N. Lucas. August 28th.

18,586. "Improvements in porcelain and other electric insulators." W. E. Langdon, J. C. Fuller, and G. Fuller. August 28th. (Complete.)

18,598. "An improved automatic electro-mechanical cut-out." J. E. Spagnoletti. August 28th.

18,602. "Improved carrier for an incandescent electric lamp." E. Taylor. August 28th.

18,624. "Improvements in electric lamps of the character known as vapour lamps or vapour arc lamps." C. O. Bastian and A. E. Salisbury. August 29th.

18,625. "An improvement of incandescent electric lamps to enable variation of their candle-power." T. W. Bullock. August 29th.

18,631. "Improvements in or relating to trolley heads for electric tramcars." J. Eagles and J. Eagles. August 29th.

18,653. "Improvements in electric switchboards and fuseboards." H. J. Read. August 29th.

18,680. "Improvements in means for controlling electrically-operated elevators." H. L. Eriksen and The Company Koefoed Hauberg, Marstrand and Helweg, Aktieselskabet, Titan. August 29th. (Complete.)

18,551. "Improvements in brush-holders for the commutators of dynamos and electric motors." J. Maclean. August 28th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1902.

2,310. "Improvements relating to electric telegraphy." A. Muirhead. Dated January 28th.

9,815. "Improvements in and connected with the prevention or minimising of sparking or the interruption of etheral telegraphic and other electric circuits." W. L. Wise. (K. Birkland.) Dated April 29th.

10,137. "Shade or reflector for electric lighting." J. B. Goodwin. Dated May 2nd.

10,204. "Improvements in electrodes for use in electrolysis." J. Hargreaves, J. W. Stubbs, and J. Kearsley. Dated May 3rd.

10,459. "Improvements in controllers for electric motors." H. J. Haddan. (D. Bergman.) Dated May 6th.

11,101. "Improvements in electric clocks." O. Romanze and F. S. Elliott. Dated May 14th.

11,819. "Improvements relating to the insulation of the conductors or windings of electrical apparatus." H. H. Lake. (General Electric Co.) Dated May 24th.

11,821. "Improvements in electrical brush-holders and brushes for use therein." H. H. Lake. (General Electric Co.) Dated May 24th.

11,822. "Improvements relating to the control of electro-motor and other electric circuits." H. H. Lake. (General Electric Co.) Dated May 24th.

11,844. "Improvements in or relating to devices for controlling electro-motors." H. H. Lake. (General Electric Co.) Dated May 24th.

12,290. "Improvements in pressure regulating apparatus for electric mains." C. Turnbull. Dated May 29th.

12,330. "Electric motor-starting switch." L. Rottenburg and Patterson, Cooper & Co., Ltd. Dated May 31st.

12,752. "Improvements in testing the insulation of electric cables." E. A. Claremont and C. J. Beaver. Dated June 4th.

13,539. "Improvements in electric wires." W. H. Hyatt. Dated June 14th.

12,476. "Improvements relating to electric recording apparatus, chiefly designed for use in connection with electric measuring instruments." E. Weston and A. O. Benecke. Dated May 31st.

12,691. "An improved process for the electrolytic decomposition of alkaline chlorides and apparatus therefor." H. Cuenod and C. Fournier. Dated June 3rd.

12,765. "Improvements relating to the distribution of electricity." H. H. Lake. (General Electric Co.) Dated June 4th.

12,766. "Improvements relating to apparatus for cleaning electric lamp filaments. H. H. Lake. (General Electric Co.) Dated June 4th.

12,817. "Improvements in or relating to electric switches." M. Mercier and W. O. Andrews. Dated June 5th.

12,846. "An improved controller and switch for electric motors." J. Bush and M. T. Medway. Dated June 5th.

13,082. "An improved combined electrical switch and cut-out for street poles and the like." M. Railing and J. H. Collings. Dated June 9th.

13,088. "Improvements in electric arc lamps." R. Hopfelt. Dated June 9th.

13,527. "Improvements in electrical measuring instruments." British Thomson-Houston Co. (L. T. Robinson.) Dated June 14th.

13,663. "Improvements in differential thermometers adapted for use as maximum demand indicators." G. C. Fricker. Dated June 16th.

13,738. "Improvements in electric lighting apparatus." H. H. Lake. (General Electric Co.) Dated June 17th.

13,740. "Improvements relating to insulating supports and conductors on sectional third-rail electric railways." H. H. Lake. (General Electric Co.) Dated June 17th.

13,747. "Improvements in automatic telephone exchange mechanism." R. Haddan. (Strowger Automatic Telephone Exchange.) Dated August 26th.

13,858. "Improved means for applying and removing the shade holders of electric incandescence lamps." J. W. Kirk. Dated June 18th.

13,868. "Improvements relating to electric connections or couplings." H. Beau and C. Portillo. Dated June 18th.

13,934. "Improvements in electric current transformers for high voltage circuits." British Thomson-Houston Co., Ltd. (A. R. Everett.) Dated June 19th.

14,141. "Improvements in or relating to electric switches and motor-starting devices." H. H. Lake. (General Electric Co.) Dated June 21st.

14,379. "Improvements in the mode of and in apparatus for regulating the charge and discharge of storage batteries used in conjunction with dynamo-electric machinery for supplying electrical energy." Lancashire Dynamo and Motor Co., Ltd., and R. S. McLeod. Dated June 25th.

14,319. "Improvements in electric incandescent lighting devices." C. Schwabe. Dated June 24th.

14,374. "An improved swivelling electrical collector trolley-head." National Rail and Tramway Appliance Co., Ltd., and P. McCullough. Dated June 25th.

14,464. "Improvements in portable electric transformers." E. E. Maddox. Dated June 30th.

14,523. "Improvements relating to electric ignition devices for motor cycles and other services." A. P. Maxfield and C. R. Garrard. Dated June 30th.

14,836. "Improvements in the field-magnet cores of dynamo-electric apparatus." K. Kishi. Dated July 3rd.

15,325. "Improvements in apparatus for controlling electric currents, chiefly designed for use in lighting the stages of theatres." L. Mornat. Dated July 9th.

15,716. "Improvements in or connected with electric cable or conductor junction and like boxes." C. D. Burnet. Dated July 15th.

15,749. "Improvements in sparking coil casings." C. F. Splitdorf. Dated July 15th.

16,014. "An improved form of wattmeter for the measurement of electrical power." C. V. Drysdale. Dated July 18th.

16,492. "Improvements in electrical cut-outs and regulators." H. Leitner and R. N. Lucas. Dated July 24th.

16,740. "Improvements in electro-magnetic motors and generators." A. Zehden. Dated July 28th.

17,222. "Improvements in electric cranes, winches and the like." F. W. S. Stokes. Dated August 5th.

17,388. "Improvements in systems of electrical distribution." H. H. Lake. (General Electric Co.) Dated August 7th.

17,667. "A new or improved maximum demand indicator for alternating electric currents." C. J. Evans. Dated August 12th.

17,687. "Improvements in maximum demand electrical indicators." H. H. Lake. (General Electric Co.) Dated August 12th.

18,076. "Improvements in systems of electrical distribution." British Thomson-Houston Co., Ltd. (M. O. Troy.) Dated August 16th.

18,077. "Improvements in electric current collectors." British Thomson-Houston Co., Ltd. (E. D. Priest.) Dated August 16th.

18,079. "Improvements in protective devices for electric circuits." British Thomson-Houston Co., Ltd. (C. P. Steinmetz.) Dated August 16th.

18,082. "Improvements in charging devices for storage batteries." British Thomson-Houston Co., Ltd. (H. Lemp.) Dated August 16th.

18,090. "Improvements in electric meters." British Thomson-Houston Co., Ltd. (E. J. King.) Dated August 16th.

18,229. "Improvements relating to field coils for dynamo-electric machines." H. H. Lake. (General Electric Co.) Dated August 19th.

18,319. "Improvements in electric arc lamps." British Thomson-Houston Co., Ltd. (R. Fleming.) Dated August 20th.

18,321. "Improvements in systems of electrical distribution." British Thomson-Houston Co., Ltd. (C. W. Stone.) Dated August 20th.

18,326. "Improvements in means for preventing creeping of electric meters." British Thomson-Houston Co., Ltd. (A. D. Lunt.) Dated August 20th.

18,324. "Improvements in systems of dynamo-electric machines." British Thomson-Houston Co., Ltd. (F. H. Jeanin.) Dated August 20th.

19,110. "Improvements in electric arc lamps." F. J. Green. Dated September 1st.

20,237. "Improvements in selective calls for telephones and telegraphs." W. Palmer and A. McClintock. Dated September 16th.

22,675. "An improvement in electric trolley heads with a disc-finding apparatus attached." J. T. Cherry and E. H. Clive. Dated October 18th.

24,742. "Improvements in or connected with electric railways or a mixed battery and conductor system." W. N. Stewart and H. E. Dick. Dated November 11th.

25,805. "An electric heat indicator and fire alarm." G. A. Darby. Dated November 24th.

26,476. "Improvements in or relating to overload conductors for electric railway and the like systems." C. de Kando. Dated December 1st.

26,868. "A new or improved device for use in or with electrolytic apparatus." A. Wright. Dated December 5th.

27,133. "Means for applying electricity to the body superficially." A. R. Mosler. Dated December 9th.

27,540. "Improvements in or relating to arc lamps." T. L. Carbone. Dated December 13th.

27,720. "Improvements in electric batteries." D. H. Wilson. Dated December 16th.

28,018. "Improvements in negative electrodes for electric accumulators and in the method of forming them." Chloride Electrical Storage Co., Ltd. (Soc. Anon. pour le Travail Electrique des Metaux.) Dated December 18th.

28,167. "Improvements in electric system of signalling for railways." H. G. Brown. Dated December 20th.

28,781. "Improvements in conduits or carriers for electric cables." W. Oates. Dated December 29th.

28,789. "Improvements relating to rheostats or heaters." C. E. Freeman. Dated December 30th.